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CHEMISTRY Musing

**PROBLEM
SET 78**

Chemistry Musing was started from August '13 issue of Chemistry Today. The aim of Chemistry Musing is to augment the chances of bright students preparing for JEE (Main and Advanced) / NEET with additional study material.

In every issue of Chemistry Today, 10 challenging problems are proposed in various topics of JEE (Main and Advanced) / NEET. The detailed solutions of these problems will be published in next issue of Chemistry Today.

The readers who have solved five or more problems may send their solutions. The names of those who send atleast five correct solutions will be published in the next issue. We hope that our readers will enrich their problem solving skills through "Chemistry Musing" and stand in better stead while facing the competitive exams.

JEE MAIN/NEET

- The homogeneous gaseous reaction, $2\text{SO}_2 + \text{O}_2 \rightleftharpoons 2\text{SO}_3$ is carried out in a 2 litre flask at 300 K. The flask initially contains 0.1 mole of SO_2 and SO_3 . The total pressure of the reaction mixture, after the equilibrium has been attained, is 2.78 atm. Calculate equilibrium constant K_p .
(a) 25.56 (b) 15.33 (c) 49.13 (d) 31.33
- During the preparation of ethane by Kolbe's electrolytic method using inert electrode, the pH of the electrolyte
(a) decreases progressively as the reaction proceeds
(b) increases progressively as the reaction proceeds
(c) remains constant throughout the reaction
(d) decrease if concentration of the electrolytes is not very high.
- On passing Cl_2 water in a mixture of KBr and KI solution in contact with CCl_4 continuously with occasional shaking, we observe
(a) orange CCl_4 layer changing to violet
(b) persisting violet CCl_4 layer
(c) persisting brown layer
(d) violet layer changing into brown and finally colourless.
- The enthalpy of hydrogenation of cyclohexene is $-119.5 \text{ kJ mol}^{-1}$. If resonance energy of benzene is $-150.4 \text{ kJ mol}^{-1}$, its enthalpy of hydrogenation would be
(a) $-269.9 \text{ kJ mol}^{-1}$ (b) $-358.5 \text{ kJ mol}^{-1}$
(c) $-508.9 \text{ kJ mol}^{-1}$ (d) $-208.1 \text{ kJ mol}^{-1}$
- A conductivity cell, when filled with an aqueous solution of 0.02 M KCl at 25°C , had a resistance of 250 ohm. Its resistance, when filled with $6 \times 10^{-5} \text{ M}$ NH_4OH solution was 10^5 ohm. The specific conductance of 0.02 M KCl was 0.277 S m^{-1} . The molar conductances at infinite dilution of NH_4^+ and OH^- ions are 73.4×10^{-4} and $198 \times 10^{-4} \text{ S m}^2 \text{ mol}^{-1}$,

respectively. The degree of dissociation of $6 \times 10^{-5} \text{ M}$ NH_4OH solution is

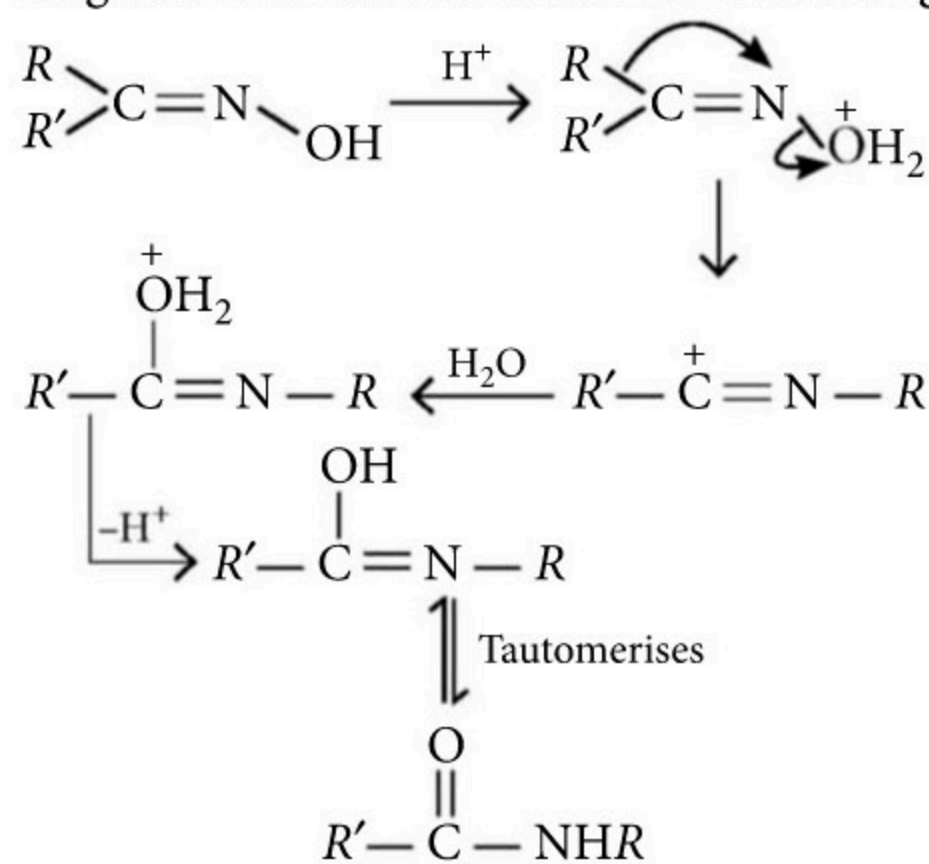
- (a) 0.424 (b) 0.344
(c) 0.512 (d) 0.792

JEE ADVANCED

- Among the following the correct statement is/are
(a) In VI A transition group, the lower oxidation state is favoured by heavier elements (Mo and W) when compared to chromium.
(b) Cu^{2+} is more stable than $\text{Cu}_{(aq)}^+$.
(c) E° of Zn^{2+}/Zn is more negative than expected because of extra stability of d^{10} configuration
(d) In 3d-series Mn^{3+} and Co^{3+} are the strongest oxidizing agents in aqueous solution when only +3 oxidation state is considered.

COMPREHENSION

In organic chemistry various reactions take place by rearrangements. These rearrangements can be classified on the basis of migratory group and its nature. One of the well-known rearrangement is the formation of N-substituted amides by rearrangement of aldoxime or ketoxime. This is known as Beckmann rearrangement. It is catalysed by various acidic reagents. The mechanism of this reaction is given as





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HIGHLIGHTS:

- Chapterwise questions of last 32 years' (2019-1988) of NEET/AIPMT
- Chapterwise segregation of questions to help you assess the level of effort required to succeed
- An unmatched question bank series with close to 1,000 pages having detailed solutions by experts



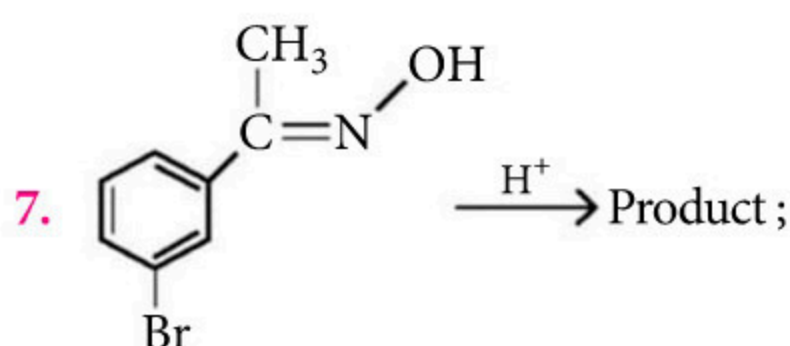
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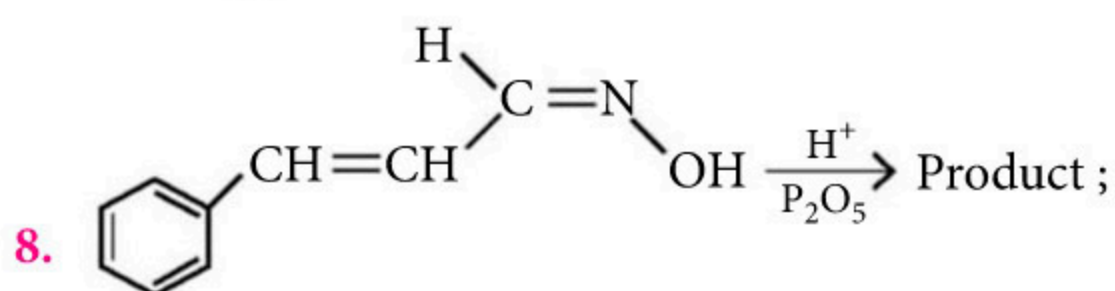
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The product formed is

- (a) (b)
 (c) (d) none of these.



The final product is

- (a)
 (b)
 (c)
 (d)

INTEGER VALUE

9. The amount of substance containing 60% NaCl, 37% KCl should be weighed (in g) out for analysis so that after the action of 25 mL of 0.1 N AgNO_3 solution, excess of Ag^+ is back titrated with 5 mL of NH_4SCN solution is (Given that 1 mL of NH_4SCN = 1.1 mL of AgNO_3)
10. A vertical cylinder closed at both ends, is divided into two parts by a frictionless piston, each part containing one mole of air. At temperature 300 K, the volume of upper part is 4 times than that of the lower part. At what temperature (in K) will the volume of the upper part be three times than that of lower part?

Government is working to scrap school examinations from 2021: MHRD

The HRD minister Ramesh Pokhriyal Nishank has given its approval to work on the evaluation module, and the ministry will soon communicate the boards to work on the '5+3+3+4' structure, as informed by an HRD official. As per recommendations of the draft National Education Policy (NEP) committee, the Human Resource Development (MHRD) ministry has decided to modernise the evaluation process by doing away with school examinations from 2021. The new evaluation module will stress on class-based assessments and follow the '5+3+3+4' structure, stated an HRD official.

The government is examining all possibilities to finalise the National Education Policy by October 2020, and the policies will be implemented from 2021. "We will soon notify the boards for their recommendations on the new exam structure recommended by the committee. After receiving suggestions from the boards and education experts, the ministry will consider to junk 10+2 format, and to proceed on the proposed evaluation process from 2021," the official told. The draft National Education Policy (NEP) committee in June recommended the 5+3+3+4 design comprising five years of foundation stage (three years of pre-primary school (classes one and two), three years of preparatory stage (classes three to five), three years of middle stage (classes six to eight), and four years of secondary stage (classes 9 to 12).

The committee proposed the new structure on the lines of an international school-based evaluation process, which assesses a student on the basis of their class-based performance. The committee noted that the current board examinations force a student to concentrate only on a few subjects without providing scope to learn in a formative manner, which ultimately causes stress among students.

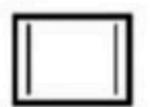


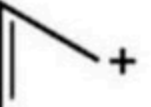

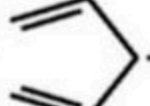


"To track students' progress throughout their school experience, the draft policy proposes State Census Examinations in classes three, five and eight. Further, it recommends restructuring the board examinations to test only core concepts, skills and higher order capacities. These board examinations will be on a range of subjects. The students can choose their subjects, and the semester when they want to take these board exams. The school final examinations may be replaced by these board examinations," the committee recommended.

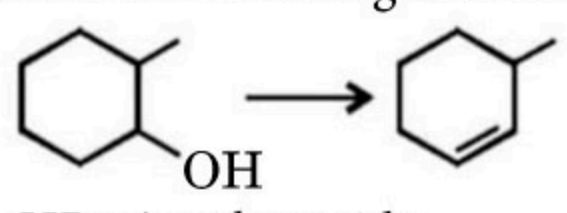
The ministry is also considering extending the ages of free learning under Right to Education (RTE) act from 14 years to 18 years. "As proposed by the draft NEP committee, the ministry is working to include early childhood education and secondary school education under the ambit of the RTE Act. This would extend the coverage of the act to all children between the ages of three to 18 years," the official mentioned. Meanwhile, Gujarat, West Bengal and Odisha has re-introduced the pass-fail system in schools. The modernisation of Higher Education system is under consideration and the ministry has proposed to set up a National Higher Education Regulatory Authority (NHERA). "The setting up of independent regulatory authority by reducing the functions of too many regulators will help the colleges and varsities to take independent decisions. The independent authority will help to limit the role of AICTE, Bar Council of India, and University Grants Commission (UGC)," the official commented. The committee also recommends setting up higher education institutions through a Higher Education Institution Charter from NHERA, limiting the role of Parliament or state legislature. "The newly constituted higher educational institutions must receive accreditation as mandated by NHERA within five years of being established," the committee proposed.

GEAR UP FOR JEE MAIN 2020

Between 6th to 11th January, 2020

with Numerical Value Type Questions

- Which one of the following characteristics of the transition metal is associated with their catalytic activity?
 - High enthalpy of atomisation
 - Paramagnetic behaviour
 - Colour of hydrated ions
 - Variable oxidation states
- What formal charges are present in the compound $C_6H_5C \equiv N - O$?
 - N is -1 and C is +1
 - N is +1 and C is -1
 - O is -1 and C is +1
 - O is -1 and N is +1
- Which of the following rate laws has an overall order of 0.5 for reaction involving substances x, y and z?
 - Rate = $k(C_x)(C_y)(C_z)$
 - Rate = $k(C_x)^{0.5}(C_y)^{0.5}(C_z)^{0.5}$
 - Rate = $k(C_x)^{1.5}(C_y)^{-1}(C_z)^0$
 - Rate = $k(C_x)(C_z)^n/(C_y)^2$
- Which of the following option is incorrect comparison of stability?
 -  <  (b)  + >  +
 -  - >  - (d)  + >  +
- Aqueous solutions of two compounds M-O-H and M'-O-H have been prepared in two different beakers. If the electronegativity of M = 3.5, M' = 1.72, O = 3.0 and H = 2.1, then the solutions respectively are
 - acidic, acidic
 - acidic, basic
 - basic, basic
 - basic, acidic.
- The main structural feature of proteins is
 - ester linkage
 - ether linkage
 - peptide linkage
 - all of these.
- Which of the following sets contain only addition homopolymers?
 - Polythene, natural rubber, terylene
 - Nylon, polyester, melamine resin
 - Teflon, bakelite, orlon
 - Neoprene, PVC, polythene.
- Lindane can be obtained by reaction of benzene with
 - CH_3COCl /anhyd. $AlCl_3$
 - Cl_2 /anhyd. $AlCl_3$
 - Cl_2 /sunlight
 - CH_3Cl /sodium metal.
- Why is ferric hydroxide colloids positively charged when prepared by adding ferric chloride to hot water?
 - Due to precipitation of ferric hydroxide there is an excess of Fe^{3+} ions.
 - Due to preferential adsorption of Fe^{3+} ions by the sol of $Fe(OH)_3$.
 - Due to absence of any negatively charged ion.
 - Due to adsorption of OH^- and Cl^- ions, the remaining sol has only Fe^{3+} ions.
- A certain gas diffuses from two different vessels A and B. The vessel A has a circular orifice while vessel B has a square orifice of length equal to the radius of the orifice of vessel A. The ratio of the rates of diffusion of the gas from vessel A to vessel B, assuming same temperature and pressure, is
 - $\pi : 1$
 - $1 : \pi$
 - $1 : 1$
 - $2 : 1$
- The relation between the d-spacing formula and the Bragg equation for a cubic crystal for first-order reflection is
 - $\sin \theta = \frac{\lambda}{2a}(h^2 + k^2 + l^2)^2$
 - $\sin \theta = \frac{\lambda}{2a}(h^2 + k^2 + l^2)^{1/2}$
 - $\sin \theta = \frac{2a}{\lambda}(h^2 + k^2 + l^2)^{1/2}$
 - $\sin \theta = \frac{2a}{\lambda}(h^2 + k^2 + l^2)^2$
- Which of the following is the best set of reagents to perform the following conversion?



 - HBr, Δ ; t-butoxide
 - H_3PO_4 , Δ ; conc. OH^-
 - CH_3COOH ; Heat
 - Al_2O_3 , Pyridine, $250^\circ C$

13. The pK_b for fluoride ion at 25°C is 10.83, the ionization constant of hydrofluoric acid at this temperature is
 (a) 1.74×10^{-5} (b) 3.52×10^{-3}
 (c) 6.76×10^{-4} (d) 5.38×10^{-2}

14. Solutions A, B, C and D are respectively 0.1 M glucose, 0.05 M NaCl, 0.05 M BaCl_2 and 0.1 M AlCl_3 . Which one of the following pairs is isotonic?
 (a) A and B (b) B and C
 (c) A and D (d) A and C

15. The reaction in which hydrogen peroxide acts as a reducing agent is
 (a) $\text{PbS} + 4\text{H}_2\text{O}_2 \rightarrow \text{PbSO}_4 + 4\text{H}_2\text{O}$
 (b) $2\text{KI} + \text{H}_2\text{O}_2 \rightarrow 2\text{KOH} + \text{I}_2$
 (c) $\text{Ag}_2\text{O} + \text{H}_2\text{O}_2 \rightarrow 2\text{Ag} + \text{H}_2\text{O} + \text{O}_2$
 (d) $\text{H}_2\text{SO}_3 + \text{H}_2\text{O}_2 \rightarrow \text{H}_2\text{SO}_4 + \text{H}_2\text{O}$

16. Match the lists I (Complex) and list II (Geometry and magnetic moment) and pick the correct matching from the codes given below.

List I

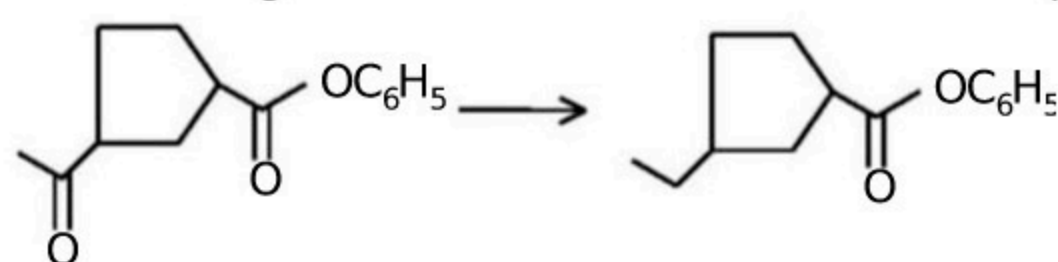
- (A) $[\text{Ag}(\text{CN})_2]^-$ 1. Square planar and 1.73 B.M.
 (B) $[\text{Cu}(\text{CN})_4]^{3-}$ 2. Linear and zero
 (C) $[\text{Cu}(\text{CN})_6]^{4-}$ 3. Octahedral and zero
 (D) $[\text{Cu}(\text{NH}_3)_4]^{2+}$ 4. Tetrahedral and zero
 (E) $[\text{Fe}(\text{CN})_6]^{4-}$ 5. Octahedral and 1.73 B.M.

- (a) A - 2, B - 4, C - 5, D - 1, E - 3
 (b) A - 5, B - 4, C - 1, D - 3, E - 2
 (c) A - 1, B - 3, C - 4, D - 2, E - 5
 (d) A - 4, B - 5, C - 2, D - 1, E - 3

17. x g of Zn metal was mixed with $2x$ g of iodine to form ZnI_2 . Which of the reactants will remain in reaction and what fraction of it remains unreacted? (Zn = 65, I = 127)
 (a) Zn, 0.75 (b) I_2 , 0.49
 (c) Zn, 0.49 (d) I_2 , 0.75

18. Pick up the incorrect statement.
 (a) Asbestos and willemite are silicate minerals.
 (b) Anglesite and barytes are sulphate minerals.
 (c) Sylvine and fluorspar are halide minerals.
 (d) Calamine and zincite are the minerals of calcium.
19. In the manufacture of sulphuric acid by contact process, Tyndall box is used to
 (a) convert SO_2 to SO_3
 (b) test the presence of dust particles
 (c) filter the dust particles
 (d) remove impurities.

20. The following transformation can be best effected by



- (a) $\text{B}_2\text{H}_6/\text{THF}$
 (b) LiAlH_4
 (c) $\text{Zn} \cdot \text{Hg}/\text{HCl}$
 (d) Raney Ni.

NUMERICAL VALUE TYPE

21. For the galvanic cell,
 $\text{Ag} | \text{AgCl}_{(aq)}, \text{KCl} (0.2 \text{ M}) || \text{KBr} (0.001 \text{ M}), \text{AgBr}_{(aq)} | \text{Ag}$
 calculate the emf (in V) generated with correct polarity to each electrode for a spontaneous process after taking an account of cell reaction at 25°C .
 (Given, K_{sp} of $\text{AgCl} = 2.8 \times 10^{-10}$, K_{sp} of $\text{AgBr} = 3.3 \times 10^{-13}$)
22. Calculate the energy (in kJ) required to excite one litre of hydrogen gas at 1 atm and 298 K to the first excited state of atomic hydrogen. The energy for the dissociation of H - H bonds is 436 kJ mol^{-1} .
23. About 0.000225 g of a monoacidic base required 1 mL of 0.005 N H_2SO_4 for complete neutralization. Calculate the molecular mass of the base.
24. Find out molecular formula mass of a nitrogenous base, 0.295 g of which on treating with CH_3MgI liberates 112 mL of CH_4 at STP.
25. When 12 g of carbon reacted with oxygen to form CO and CO_2 at 25°C at constant pressure, 75.0 kcal of heat was liberated and no carbon remained. Calculate the mass of oxygen needed for it. $\Delta H_f(\text{CO}_2) = -94.05 \text{ kcal mol}^{-1}$ and $\Delta H_f(\text{CO}) = -26.41 \text{ kcal mol}^{-1}$.

SOLUTIONS

1. (d): Transition elements show variable oxidation states so that they readily form intermediate complexes which explain their catalytic activity.

2. (d): For nitrogen,
 Formal charge = $5 - \frac{1}{2}(8) = +1$

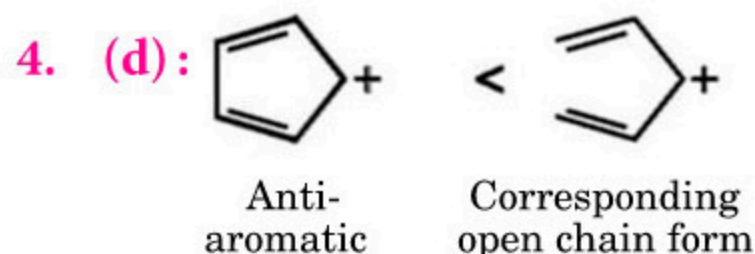
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|-----------|-------------|-----------|-----------|
| 1. (b) | 2. (a) | 3. (c) | 4. (a) |
| 5. (d) | 6. (c) | 7. (b) | 8. (d) |
| 9. (a) | 10. (d) | 11. (b) | 12. (a) |
| 13. (a) | 14. (a) | 15. (a) | 16. (c) |
| 17. (c) | 18. (a) | 19. (d) | 20. (a,c) |
| 21. (a,b) | 22. (c,d) | 23. (a,c) | 24. (8) |
| 25. (2) | 26. (60.19) | 27. (d) | 28. (c) |
| 29. (a) | 30. (b) | | |

For oxygen,

$$\text{Formal charge} = 6 - 6 - \frac{1}{2}(2) = -1$$

3. (c) : Overall order of reaction = $1.5 - 1 + 0 = 0.5$



5. (b)

6. (c) : Peptide linkage is the main structural feature of proteins.

7. (d) : Neoprene is made from chloroprene, PVC is from vinyl chloride and polyethene is from ethene monomer.

8. (c) : Lindane or benzene hexachloride is obtained by the reaction of benzene with Cl_2 /sunlight.

9. (b) : The adsorption of positively charged Fe^{3+} ions by the sol of hydrated ferric oxide results in positively charged colloid.

10. (a) : The rate of diffusion is directly proportional to the area of orifice,

$$\therefore d_A \propto \pi r^2 \text{ and } d_B \propto r^2$$

$$\therefore \frac{d_A}{d_B} = \pi \Rightarrow d_A : d_B = \pi : 1$$

11. (b) : For a cubic crystal,

$$d_{hkl} = \frac{a}{\sqrt{h^2 + k^2 + l^2}} \quad \dots(i)$$

where, a = lattice parameter; hkl = Miller indices

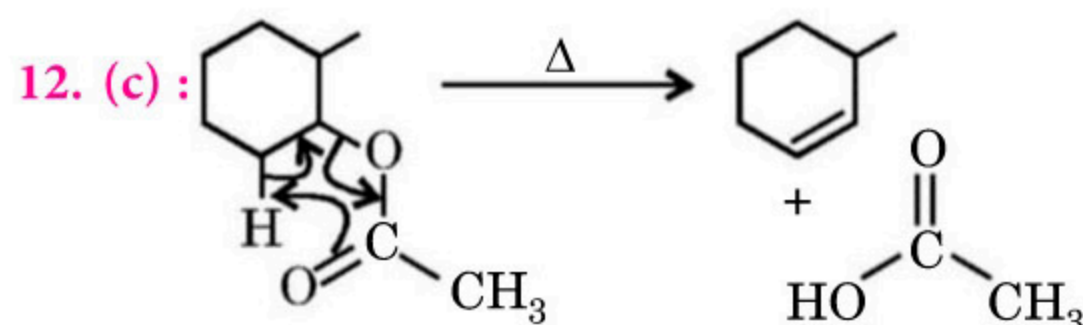
From Bragg's equation, $n\lambda = 2d_{hkl} \sin \theta$

For first-order reflection, $n = 1$

$$\therefore \lambda = 2d_{hkl} \sin \theta \quad \dots(ii)$$

From Equations (i) and (ii),

$$\sin \theta = \frac{\lambda}{2a} (h^2 + k^2 + l^2)^{1/2}$$

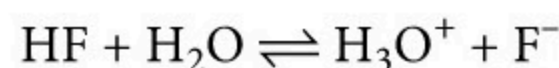


13. (c) : $\text{F}^- + \text{H}_2\text{O} \rightleftharpoons \text{HF} + \text{OH}^-$

$$K_b = \frac{[\text{HF}][\text{OH}^-]}{[\text{F}^-]} \quad \dots(i)$$

$$K_w = [\text{H}_3\text{O}^+][\text{OH}^-] = 10^{-14} \quad \dots(ii)$$

Dissociation of HF in water is represented by the equation :



$$K = \frac{[\text{H}_3\text{O}^+][\text{F}^-]}{[\text{HF}]} \quad \dots(iii)$$

Multiplying eqn. (i) and (iii)

$$K_b \cdot K = [\text{H}_3\text{O}^+][\text{OH}^-] = K_w$$

$$\frac{K_w}{K_b} = K$$

Taking log on both the sides

$$\log K = \log K_w - \log K_b = -\text{p}K_w + \text{p}K_b = -14 + 10.83 = -3.17 \text{ or,}$$

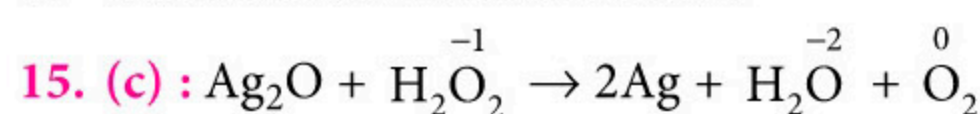
$$K = 6.76 \times 10^{-4}$$

14. (a) : For isotonic solutions $\pi_1 = \pi_2$

For 0.1 M glucose (non-electrolyte); $\pi = 0.1RT$

For 0.05 M NaCl (electrolyte produces Na^+ and Cl^- in solution); $\pi = 2 \times 0.05 RT = 0.1 RT$

\therefore Solution A and B are isotonic.



H_2O_2 is oxidized to O_2 thus acts as a reducing agent.

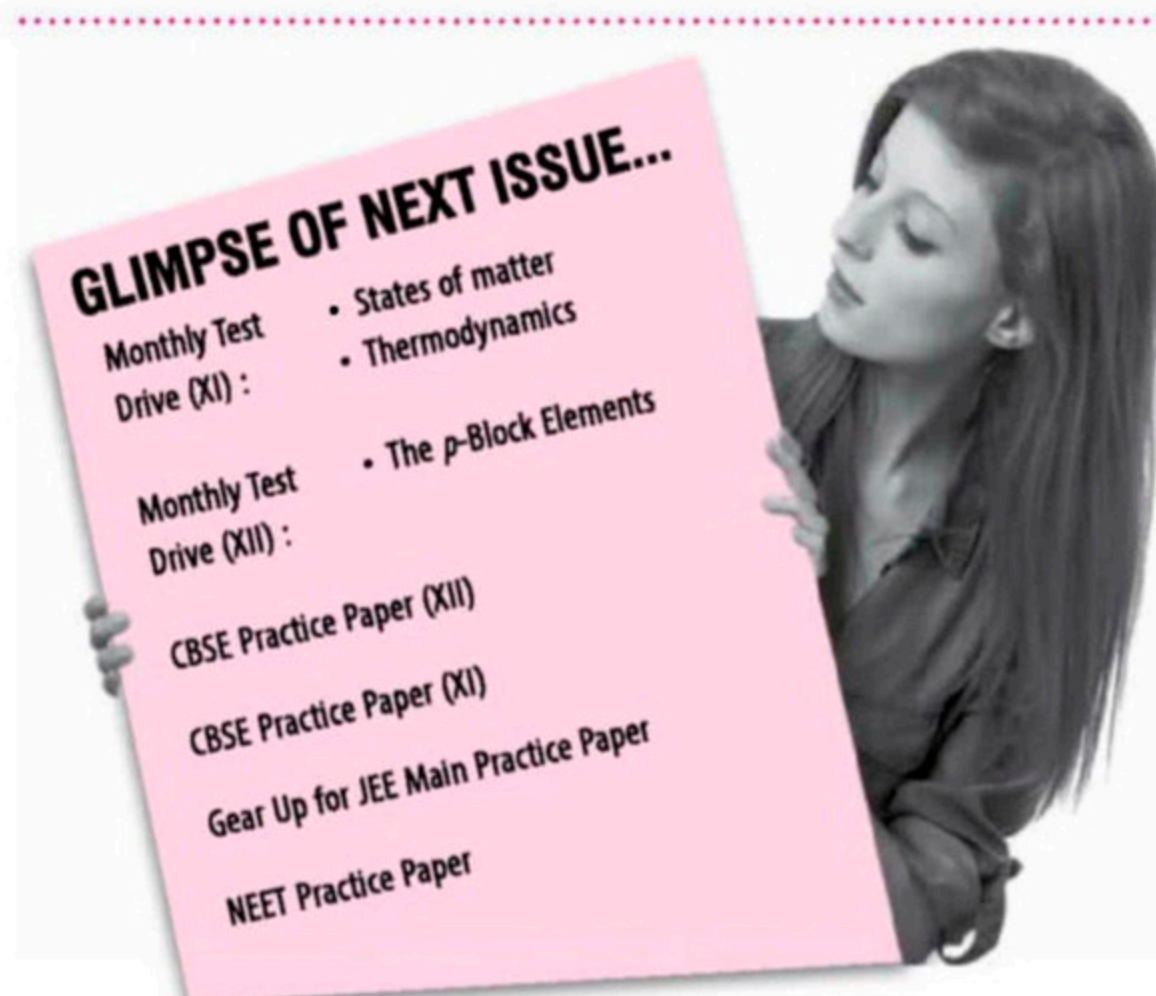
16. (a)

17. (c)

18. (d) : Calamine is ZnCO_3 and zincite is ZnO . Both are minerals of zinc.

19. (b) : In the manufacturing of H_2SO_4 by contact process, Tyndall box is used to test the presence of dust particles.

20. (d) :  / Raney Ni cannot reduce ester groups effectively.



$$21. (0.04): E_{\text{cell}} = \frac{0.0591}{1} \log \frac{[\text{Ag}^+]_{\text{R.H.S.}}}{[\text{Ag}^+]_{\text{L.H.S.}}} \quad \dots(i)$$

For L.H.S.; K_{sp} of AgCl = 2.8×10^{-10} (Given)
or $[\text{Ag}^+][\text{Cl}^-] = 2.8 \times 10^{-10}$

$$\text{or } [\text{Ag}^+] = \frac{2.8 \times 10^{-10}}{[\text{Cl}^-]} = \frac{2.8 \times 10^{-10}}{0.2} = 1.4 \times 10^{-9} \text{ M}$$

For R.H.S.; K_{sp} of AgBr = 3.3×10^{-13}
or $[\text{Ag}^+][\text{Br}^-] = 3.3 \times 10^{-13}$

$$\text{or } [\text{Ag}^+] = \frac{3.3 \times 10^{-13}}{0.001} = 3.3 \times 10^{-10} \text{ M}$$

$$\therefore \text{By (i), } E_{\text{cell}} = \frac{0.0591}{1} \log \frac{3.3 \times 10^{-10}}{1.4 \times 10^{-9}} = -0.037 \text{ V}$$

Thus, to get cell reaction, (i.e., $E_{\text{cell}} = +ve$) polarity of cell should be reversed. i.e., cell is,

Ag | AgBr_(aq.), KBr (0.001 M) || KCl (0.2 M) AgCl_(aq.) | Ag
and $E_{\text{cell}} = +0.037 \text{ V} \approx 0.04 \text{ V}$

$$22. (98.32): \text{Number of moles of H}_2 \text{ gas, } n = \frac{PV}{RT}$$

$$n = \frac{1 \times 1}{0.0821 \times 298} = 0.0409 \text{ mol}$$

Energy required to dissociate H₂ gas into atoms = $0.0409 \times 436 = 17.83 \text{ kJ/mol}$

No. of moles of H-atoms = $2 \times \text{no. of moles of H}_2 \text{ gas}$
= $2 \times 0.0409 = 0.0818 \text{ mol}$

$$\text{For H-atom, } E_n = -\frac{1312}{n^2} \text{ kJ mol}^{-1}$$

$$\therefore \Delta E = E_2 - E_1 = 1312 \left[\frac{1}{n_1^2} - \frac{1}{n_2^2} \right] \text{ kJ mol}^{-1}$$

$$n_1 = 1, n_2 = 2$$

Energy required for 0.0818 mol

$$= 1312 \left[\frac{1}{1^2} - \frac{1}{2^2} \right] \times 0.0818 = 80.49 \text{ kJ}$$

Total energy required = Energy for dissociation +
Energy for excitation
= $17.83 + 80.49 = 98.32 \text{ kJ}$

23. (45): For an acid-base reaction, at the neutralisation point,

No. of equivalents of acid = No. of equivalents of base

$$\frac{N_{(\text{acid})} \times V_{(\text{acid})}}{1000} = \frac{W_{(\text{Base})}}{\text{eq. mass of base}}$$

$$\frac{0.005 \times 1}{1000} = \frac{0.000225}{M_{(\text{Base})}} \times n\text{-factor}$$

$$\left(\text{eq. mass} = \frac{\text{Molar mass}}{n\text{-factor}} \right)$$

$$M_{(\text{Base})} = \frac{0.000225 \times 1000}{0.005 \times 1} \times 1 = 45 \text{ amu}$$

[n -factor = 1 (monoacidic base)]

\therefore Acidity of the base (n -factor) = 1

Thus, molecular mass of the base = 45 g

24. (59): Nitrogenous base which reacts with Grignard reagent is 1° or 2° amine having general formula $C_nH_{2n+3}N$.
Number of moles of CH₄ = number of moles of amine

$$\frac{112}{22400} = \frac{0.295}{\text{Molecular mass of amine}}$$

$$\text{Molecular mass of amine} = \frac{0.295 \times 22400}{112} = 59$$

$$C_nH_{2n+3}N = 59; C_nH_{2n+3} = 59 - 14 = 45;$$

$$C_nH_{2n} = 45 - 3 = 42; n = 42/14 = 3$$

Thus molecular formula is C₃H₉N and molecular formula mass = 59

Tertiary amine does not react with Grignard's reagent as it does not contain hydrogen atom present at nitrogen atom.

$$25. (27.49): C + O_2 \longrightarrow CO_2; \Delta H_f = -94.05 \text{ kcal}$$

$$C + \frac{1}{2} O_2 \longrightarrow CO; \Delta H_f = -26.41 \text{ kcal}$$

Let a moles of carbon react to form CO₂

And b moles of carbon react to form CO.

Since 12 g or 1 mole carbon is used up

$$a + b = \frac{12}{12} = 1 \quad \dots(i)$$

$$a \times 94.05 + b \times 26.41 = 75 \quad \dots(ii)$$

$$a = 0.718 \text{ i.e., mole of CO}_2 \text{ formed}$$

$$b = 0.282 \text{ i.e., mole of CO formed}$$

Also moles of O₂ used for this change

$$= 0.718 + \frac{0.282}{2} = 0.859$$

$$\text{Thus, weight of O}_2 \text{ used} = 0.859 \times 32 = 27.49 \text{ g}$$

Solution Senders of Chemistry Musing

Set - 77

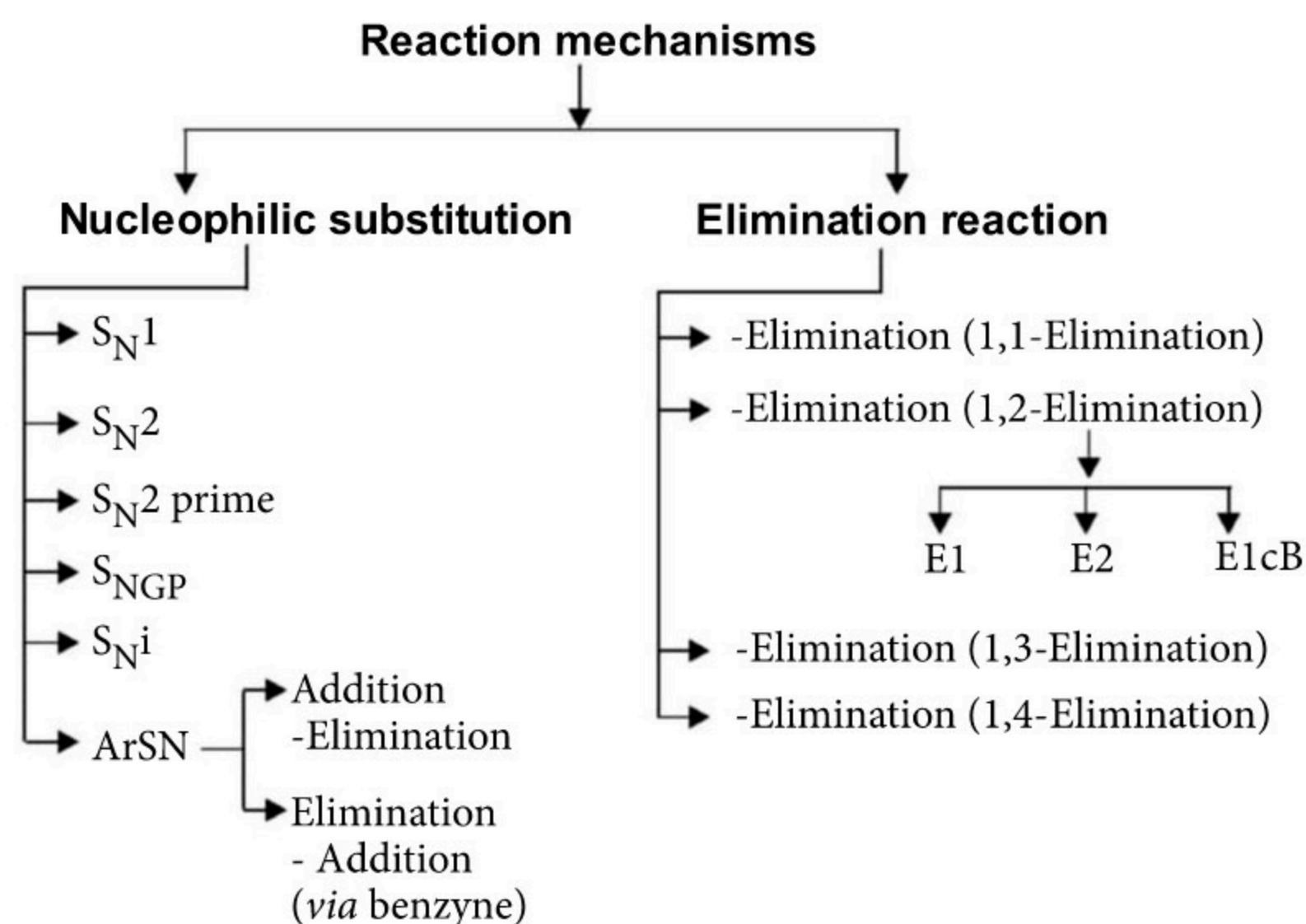
- Rakhi Malik, Haryana
- Arkaprov Datta, West Bengal
- Nitun Sarkar, Kolkata

Solution Senders of Puzzle Corner

- Renu Arora, Punjab
- Ashish Singh, Lucknow U.P.

Rank Enhancer

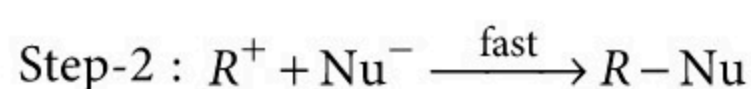
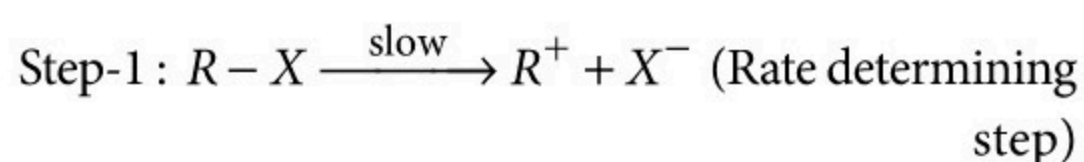
This column is specially designed to make your concepts crystal clear.



NUCLEOPHILIC SUBSTITUTION

SN1

- It takes place in two steps.



As rate determining step contains one molecule ($R-X$), it is unimolecular reaction and called S_N1 .

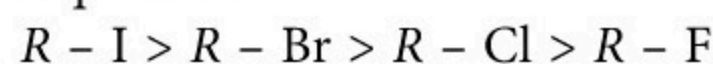
- It involves formation of reaction intermediate "carbocation". Hence, methyl shift, hydride shift and phenyl shift are possible.
- Stability order of carbocation, favourable for this mechanism is :
Benzyl > Allyl > 3° > 2° > 1° > Vinyl
- Presence of heavy metal ions (Pb^{2+} , Ag^+) catalyses S_N1 reaction by facilitating ionisation of $R-X$.
- Solvents with higher dielectric constant such as H_2O , $RCOOH$ (polar protic) and DMSO (polar

aprotic) favour S_N1 reaction due to solvation of cation.

- Stable leaving group with higher leaving tendency favours S_N1 reaction.

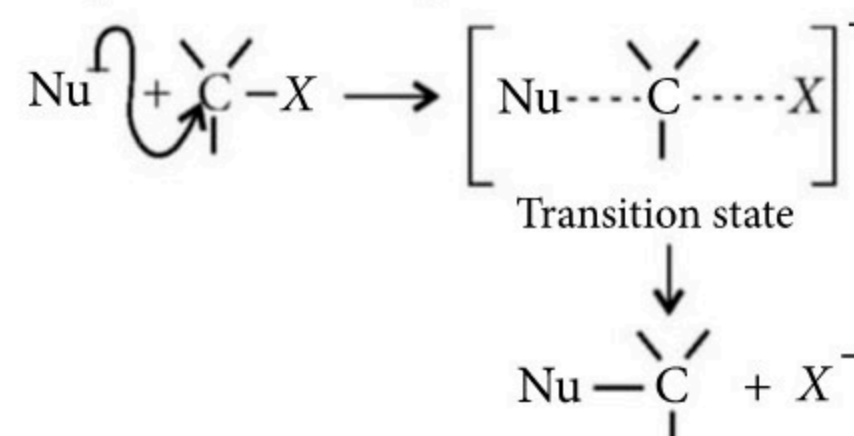
e.g., $CF_3 - SO_3^-$ (Triflate ion) is a good leaving group because of its resonance stabilisation.

Among halogens, leaving tendency follows the sequence :



SN2

- It takes place in one step.



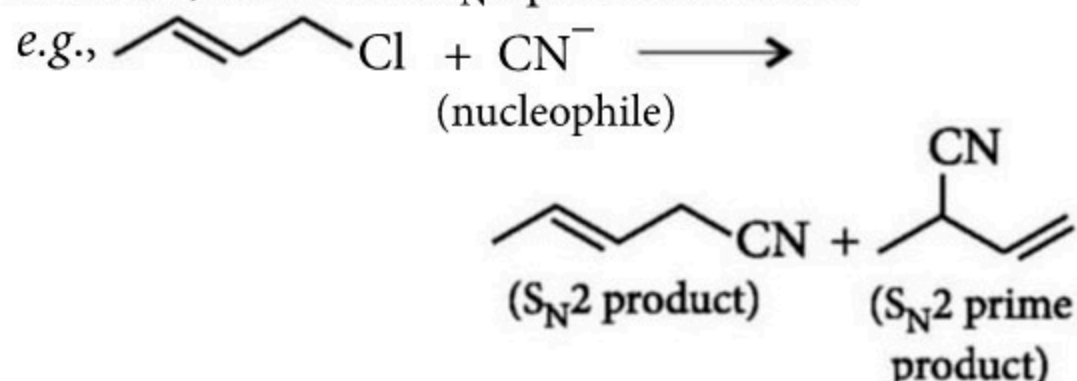
- As rate determining step involves two species, it is bimolecular reaction and called S_N2 .

By K. Vijay Bhasker, Senior faculty at Sri Chaitanya Educational Institution, Visakhapatnam

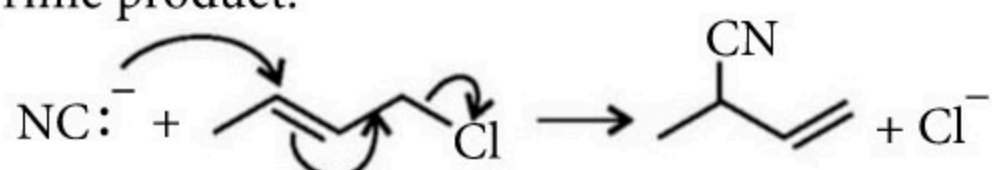
- It does not involve formation of reaction intermediate but forms "transition state". Hence, no rearrangement is possible.
- Rate of reaction depends on steric factors. Lesser the number of steric groups on target C, more will be the reactivity.
 \therefore Order of reactivity of alkyl halides in S_N2 reaction is $CH_3X > 1^\circ > 2^\circ > 3^\circ > \text{Allyl} > \text{Benzyl}$.
- This reaction is favourable when stronger base replaces weaker base.
- Nucleophilic attack will be from opposite side of the leaving group. Hence, inversion takes place. It is called as **Walden inversion**.

S_N2 prime

- When allylic rearrangement takes place in S_N2 reaction, it is called S_N2 prime reaction.

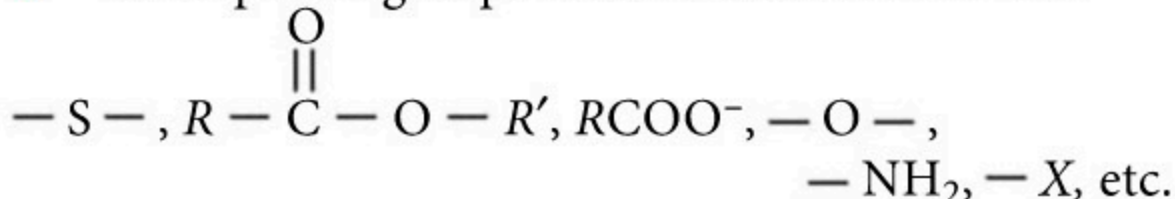


Mechanism: In presence of nucleophile, π electrons move towards leaving group and result in S_N2 prime product.

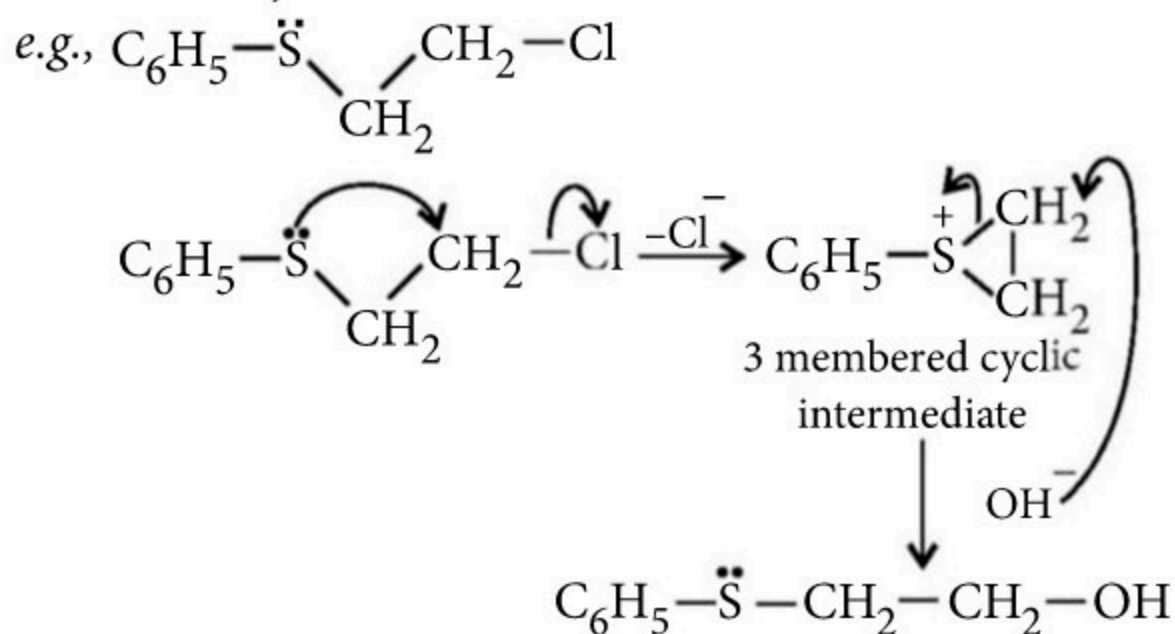


S_{NGP} – Substitution with Neighbouring Group Participation

- This reaction takes place when an atom or group having lone pair of electrons is present at β -position or far away with respect to the leaving group.
- This atom or group displaces leaving group and produces 3,4,5 or 6 membered cyclic intermediate.
- Examples of groups which can show NGP are:

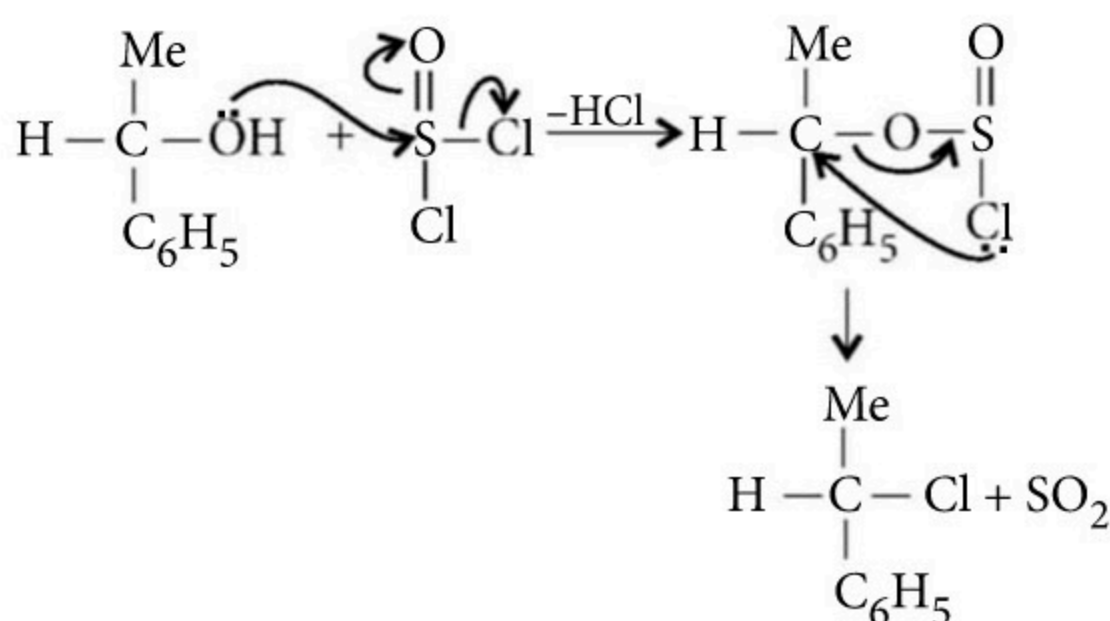


- In NGP, rate of reaction increases.



S_{Ni} (Nucleophilic Substitution Internal)

- Darzen's process of preparation of haloalkane from alcohol in absence of pyridine is called S_{Ni} .
- This reaction proceeds with retention of configuration.



(ArS_N) Aromatic Substitution of Nucleophilic Reaction

- Nucleophilic substitution in aryl halides when electron withdrawing groups (such as $-NO_2$) are present at ortho or para position w.r.t halide group is called ArS_N reaction.

ELIMINATION REACTION

α -Elimination or 1,1-Elimination

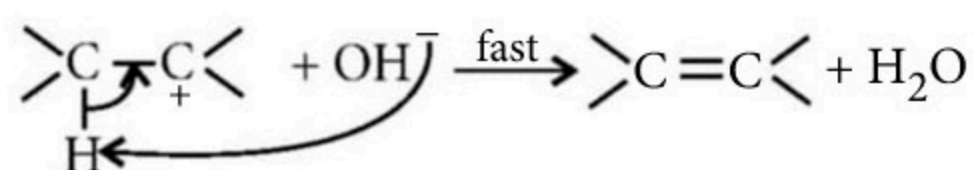
- When two groups or atoms are being eliminated from same C-atom, results in the formation of carbene is called α -elimination or 1,1-elimination.

β -Elimination or 1,2-Elimination

- When two groups or atoms are being eliminated from adjacent C-atoms, results in the formation of π -bond, such reactions are called β -elimination or 1,2-elimination.
- They are further classified into following three types:

E1 (Elimination unimolecular reaction)

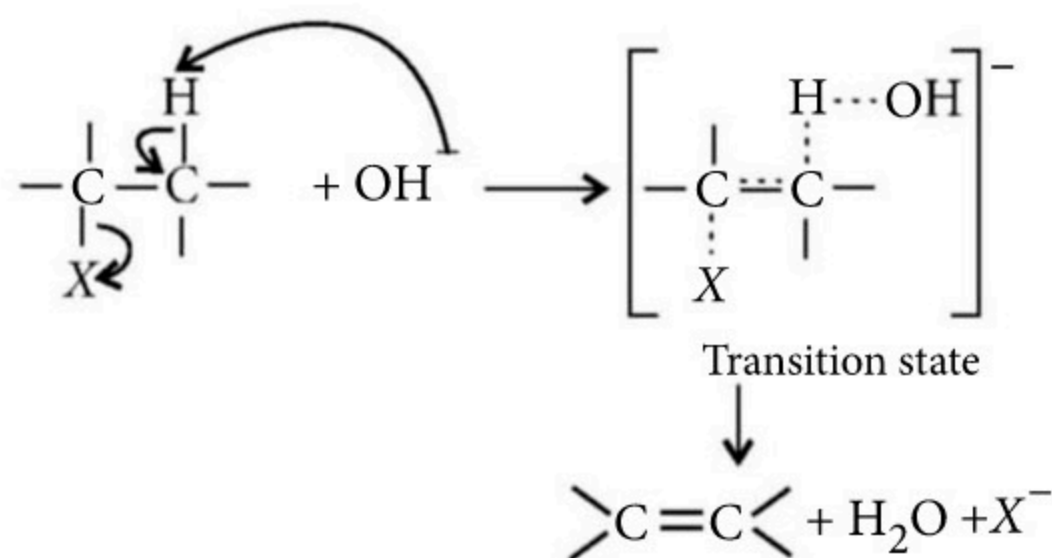
- It takes place in two steps.
 - Rate of reaction depends only on concentration of substrate such as alkyl halide but not on concentration of base.
 - 1st step is the rate determining step. It involves heterolytic dissociation of alkyl halide.
- $$\begin{array}{c} \text{>C}-\text{C}< \\ | \quad | \\ \text{H} \quad \text{Cl} \end{array} \xrightarrow{\text{RDS}} \begin{array}{c} \text{>C}-\text{C}< \\ | \quad + \\ \text{H} \quad \end{array} + \text{Cl}^-$$
- 2nd step is the removal of H^+ from carbon atom adjacent to carbocation formed in the above step by base.



- Order of reactivity towards E1 elimination :
 - With respect to substrate,
 $3^\circ \text{ benzylic} \approx 3^\circ \text{ allylic} > 2^\circ \text{ benzylic} \approx 2^\circ \text{ allylic} > 1^\circ \text{ benzylic} \approx 1^\circ \text{ allylic} > 3^\circ > 2^\circ > 1^\circ > \text{vinylic}$
 - With respect to leaving group - weaker base have better leaving tendency.
 $\therefore \text{R-I} > \text{R-Br} > \text{R-Cl} > \text{R-F}$

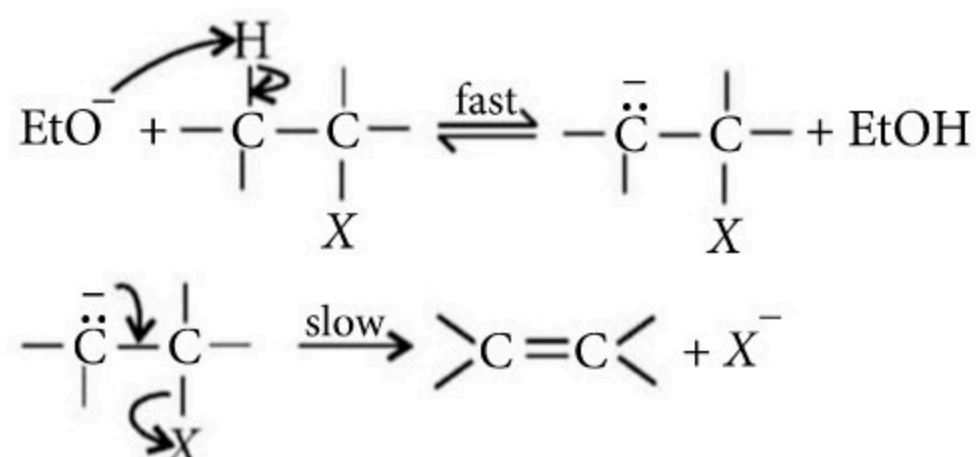
E2 (Elimination Biomolecular Reaction)

- It takes place in single step.
- Rate of reaction depends both on concentration of substrate (R-X) and reagent [OH⁻].
- It involves the formation of transition state rather than carbocation reaction intermediate.
- Trans-elimination takes place more readily than cis.
- Order of reactivity towards E2 reaction increases with decrease in steric hindrance at carbon atom.
 $\therefore 1^\circ > 2^\circ > 3^\circ$
- Among halogens leaving tendency follows the sequence :
 $\therefore \text{R-I} > \text{R-Br} > \text{R-Cl} > \text{R-F}$



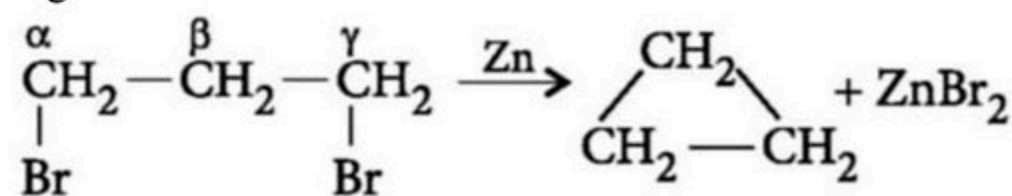
E1CB (Unimolecular Conjugate base Elimination)

- It also takes place in two steps like E1 reaction.
- Step-1 is fast and step-2 is slow. Hence step-2 is RDS.
- It involves fast reversible removal of proton from the β -carbon with the formation of a carbanion which then loses the leaving group in the second slow rate-determining step.



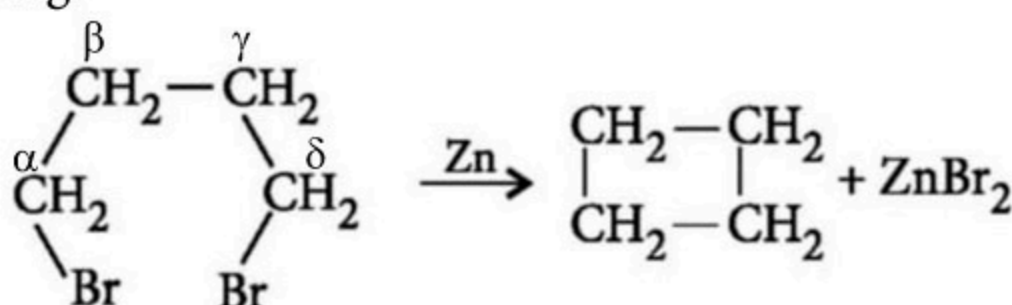
γ -Elimination or 1, 3-Elimination

- In this elimination, atoms or groups are being removed from the carbon atoms which lie three bonds away from each other *i.e.*, from α and γ positions.
- It results in the formation of three membered cyclic ring.



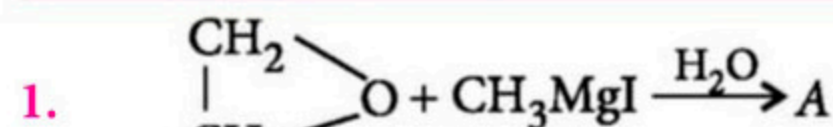
δ -Elimination or 1, 4-Elimination

- In this elimination, atoms or groups are being removed from carbon atoms which lie four bonds away *i.e.*, from α and δ -positions.
- It results in the formation of cyclic four membered ring.



QUESTIONS FOR PRACTICE

Single Option Correct Type



- A is
- (a) (b) (c) (d) none of these.

2. E2 elimination is
- (a) stereoselective (b) stereospecific
(c) both (a) and (b) (d) none of these.

UNSCRAMBLED WORDS

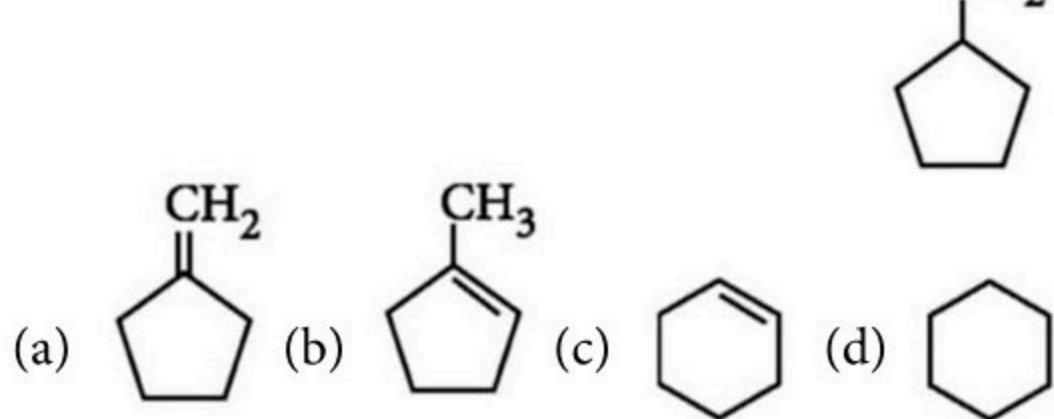
DECEMBER 2019

- | | |
|---------------|------------------|
| 1-c- CREOSOTE | 2-f- ASPHALTITES |
| 3-a- EXCIPLEX | 4-b- FUGACITY |
| 5-h- MULLITE | 6-g- OXANTHROL |
| 7-d- PATINA | 8-e- PERICLASE |

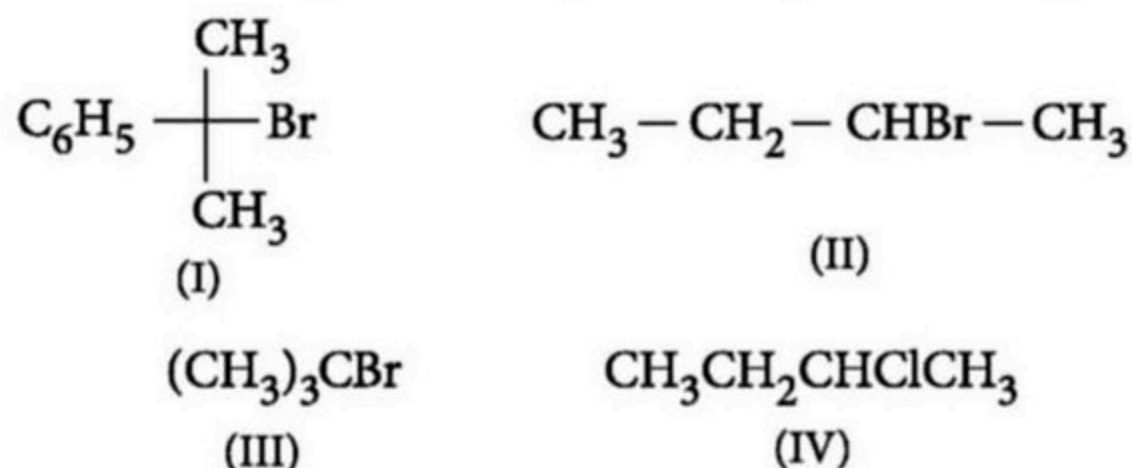
3. SN reaction of $\text{CH}_3-\text{C}(\text{CH}_3)_2-\text{CH}_2-\text{Br}$ is

- (a) fast due to 1° -haloalkane
(b) slow due to rearrangement
(c) fast due to rearrangement
(d) slow due to 1° haloalkane.

4. Which is not a dehydration product of CH_2OH ?

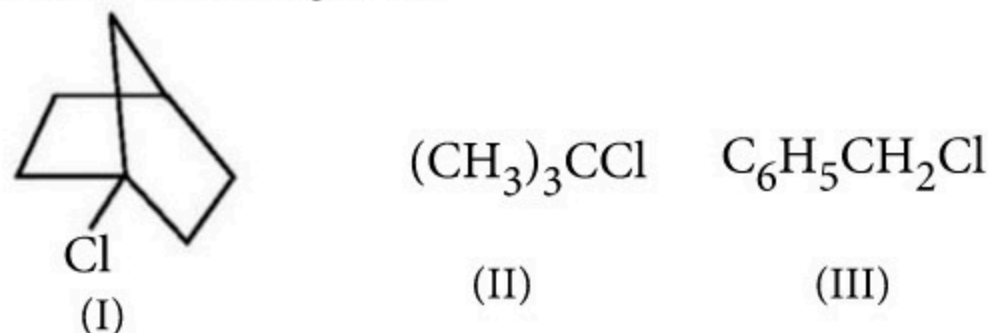


5. Increasing order of $\text{S}_{\text{N}}1$ reactivity of following is

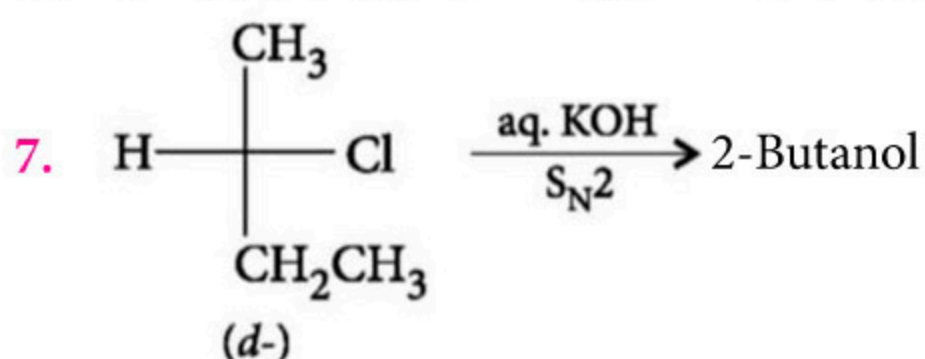


- (a) $\text{I} < \text{II} < \text{III} < \text{IV}$ (b) $\text{IV} < \text{I} < \text{III} < \text{II}$
(c) $\text{IV} < \text{I} < \text{II} < \text{III}$ (d) $\text{IV} < \text{II} < \text{III} < \text{I}$

6. Which of the following produce precipitate when treated with alc. AgNO_3 ?



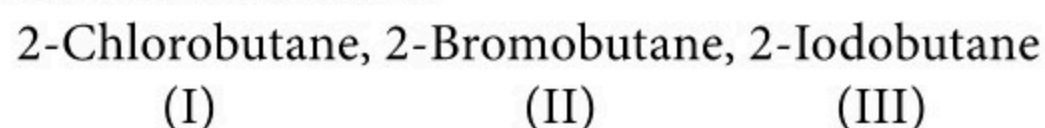
- (a) Only (I) and (III) (b) Only (II) and (III)
(c) Only (I) and (II) (d) All of these



2-Butanol is

- (a) optically dextro (b) racemic mixture
(c) optically leavo (d) no reaction possible.

8. Order of reactivity of the following towards $\text{S}_{\text{N}}2$ with NaCN in DMSO is

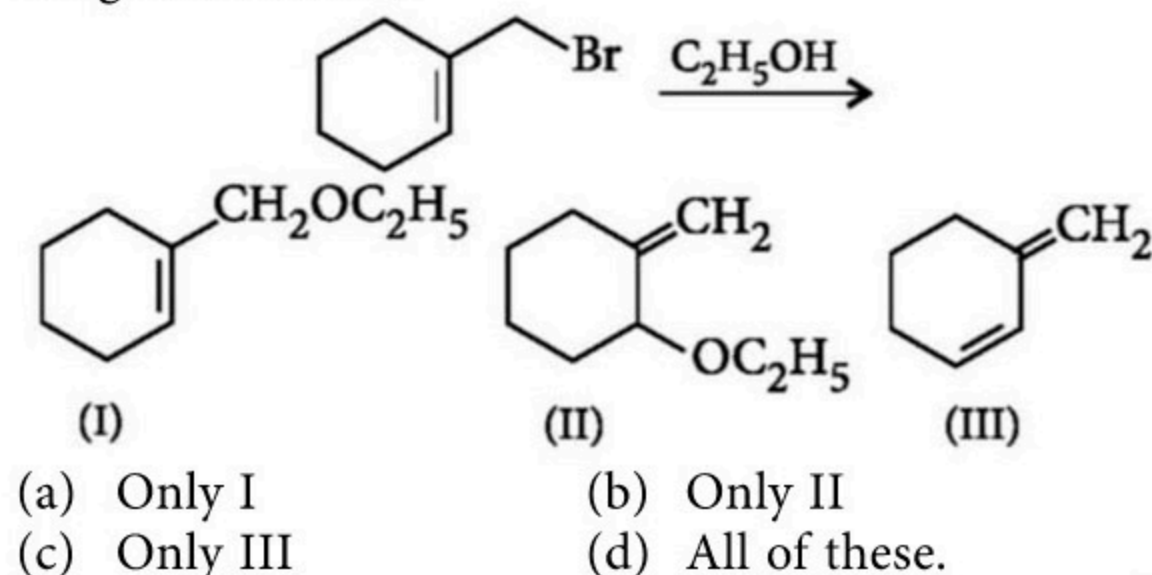


- (a) $\text{I} > \text{II} > \text{III}$ (b) $\text{I} < \text{II} < \text{III}$
(c) $\text{I} < \text{II} > \text{III}$ (d) $\text{I} > \text{II} < \text{III}$

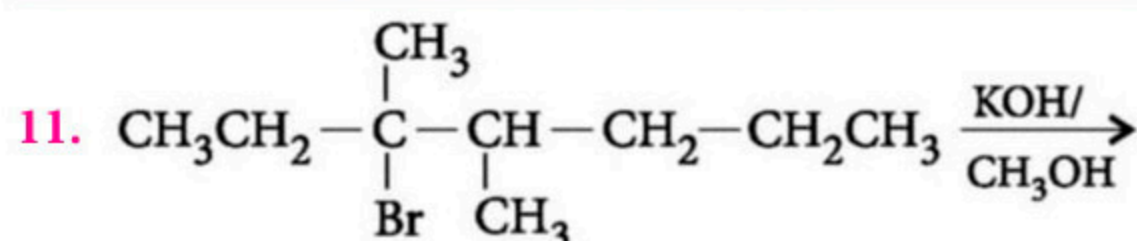
9. Vinyl chloride is inert towards

- (a) $\text{S}_{\text{N}}1$ (b) $\text{S}_{\text{N}}2$
(c) both (a) and (b) (d) none of these

10. Which of the following products are possible in the given reaction?



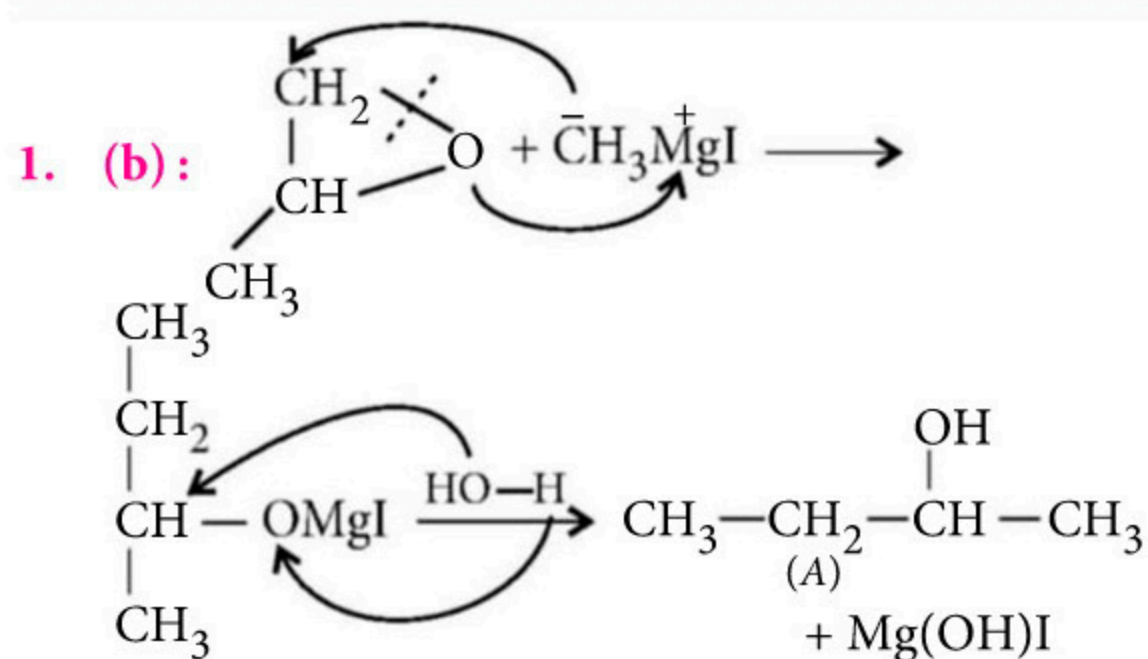
Integer Type Questions



No. of E1 products possible (without optical isomers) is

12. Total number of $\text{S}_{\text{N}}1$ and E1 products of 1-bromo-1-methylcyclohexane is

Hints & Solutions



EXAM ALERT 2020

Exam	Date
JEE Main I	6 th to 11 th January
WB JEE	2 nd February
JEE Main II	3 rd to 9 th April
SRMJEEE	12 th to 20 th April
KEAM	20 th to 21 st April
NEET	3 rd May
MHT CET	16 th to 20 th May
JEE Advanced	17 th May

2. (b): E2 elimination is stereospecific.
3. (b): After removal of Br^- , 1° carbocation is formed. It undergoes rearrangement by 1,2-methyl shift to form 3° carbocation. Hence it occurs slowly.
4. (d): (a) and (b) are simple elimination products. (c) is ring expansion product.
5. (d): $\text{IV} \Rightarrow 2^\circ$, C – Cl B.E. more
 $\text{II} \Rightarrow 2^\circ$, C – Br B.E. less
 $\text{III} \Rightarrow 3^\circ$
 $\text{I} \Rightarrow 3^\circ$, phenyl group
6. (b): Carbocation on bridged C is unstable.
7. (c): In $\text{S}_{\text{N}}2$, due to Walden inversion dextro will be converted to laevo.
8. (b): All are 2° haloalkanes.
 \therefore Order of reactivity \propto Leavability
 and leavability order is $\text{I} > \text{Br} > \text{Cl}$.
9. (c): In vinyl chloride, bond energy is more due to partial double bond character and carbocation is unstable.
10. (d): (I) gives $\text{S}_{\text{N}}1$ product without rearrangement.
 (II) gives $\text{S}_{\text{N}}1$ product with rearrangement.
 (III) gives E1 product.
11. (5): $\text{CH}_3-\text{CH}_2-\overset{\text{CH}_2}{\underset{\text{CH}_3}{\text{C}}}-\text{CH}-\text{CH}_2-\text{CH}_2-\text{CH}_3$
- $\text{CH}_3-\text{CH}=\overset{\text{CH}_3}{\underset{\text{CH}_3}{\text{C}}}-\text{CH}-\text{CH}_2-\text{CH}_2-\text{CH}_3$
 (2 geometrical isomers)
- $\text{CH}_3-\text{CH}_2-\overset{\text{CH}_3}{\underset{\text{CH}_3}{\text{C}}}=\text{C}-\text{CH}_2-\text{CH}_2-\text{CH}_3$
 (2 geometrical isomers)
12. (3): $\text{S}_{\text{N}}1$ products = 1
 E1 products = 2
 Total = 3

UNSCRAMBLE ME

Unscramble the words given in column I and match them with their explanations in column II.

Column I

1. CPOERDIAE
2. NAMIATNSI
3. IXNBI
4. PECXERACSEL
5. ARIFLTTE
6. RALESZ TOTE
7. BANESERU
8. LRKIMUI

Column II

- (a) A group of very toxic cyclic peptides found in the mushroom.
- (b) A trivial name for cycloheptane, C_7H_{14} a colourless liquid b.pt 118°C .
- (c) The trade name of soil conditioner. Generally has an active ingredient, a copolymer of about equal molar proportions of vinyl ethanoate and partial methyl monoester of maleic acid.
- (d) Containing CF_3SO_3^- group, a strongly acidic group.
- (e) Carotenoid carboxylic acid derivative. Violet-red needles m.pt. 198°C used for colouring food stuff.
- (f) Containing CN_4 ring, used as precursors for heterocycle in pharmaceutical etc.
- (g) Wax like fatty acids obtained from body fats after death.
- (h) Two cup shaped molecules linked together to form a molecular trap used to examine unstable species.

Readers can send their responses at editor@mtg.in or post us with complete address by 10th of every month. Names of solution senders will be published in next issue.



Exam on 2nd Feb 2020

WB

PRACTICE PAPER 2020

CATEGORY-I (Q. 1 to Q. 30)

Carry 1 mark each and only one option is correct. In case of incorrect answer or any combination of more than one answer, 1/4 mark will be deducted.

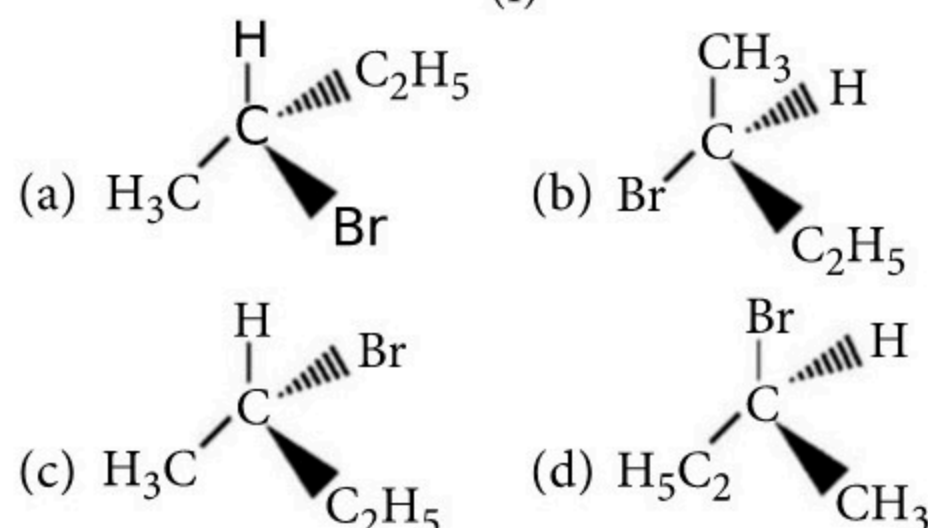
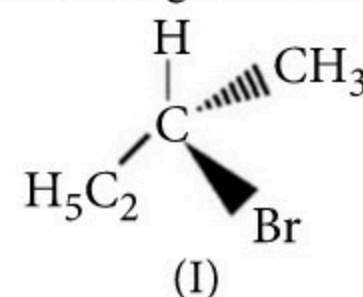
- Consider a binary mixture of volatile liquids (A and B). If at $x_A = 0.4$ the vapour pressure of solution is 580 torr then the mixture could be respectively ($p_A^\circ = 300$ torr, $p_B^\circ = 800$ torr)
 - CHCl_3 and CH_3COCH_3
 - $\text{C}_6\text{H}_5\text{Cl}$ and $\text{C}_6\text{H}_5\text{Br}$
 - C_6H_6 and $\text{C}_6\text{H}_5\text{CH}_3$
 - $n\text{C}_6\text{H}_{14}$ and $n\text{C}_7\text{H}_{16}$
- Haemoglobin contains 0.334% of iron by weight. The molecular weight of haemoglobin is approximately 67200 u. The number of iron atoms (Atomic weight of Fe is 56 u) present in one molecule of haemoglobin is
 - 1
 - 2
 - 4
 - 6
- Complete the following reactions by filling the appropriate choice.

$$6\text{XeF}_4 + 12\text{H}_2\text{O} \rightarrow 4\text{Xe} + 2\text{XeO}_3 + \text{(i)} + \text{(ii)}$$

$$\text{XeF}_6 + 3\text{H}_2\text{O} \rightarrow \text{(iii)} + 6\text{HF}$$

(i)	(ii)	(iii)
(a) F_2	H_2O	XeOF_4
(b) 24HF	3O_2	XeO_3
(c) 2HF	$2\text{H}_2\text{O}$	XeO_3
(d) HF	H_2O	Xe_2O_3
- For $[\text{HgI}_3]^-$ ion, geometry and magnetic behaviour are respectively
 - trigonal bipyramidal and paramagnetic
 - trigonal pyramidal and diamagnetic
 - trigonal planar and paramagnetic
 - trigonal planar and diamagnetic.
- In the disproportionation reaction, $\text{H}_3\text{PO}_2 \rightarrow \text{PH}_3 + \text{H}_3\text{PO}_3$; if molecular weight of H_3PO_2 is m then the equivalent mass of H_3PO_2 will be
 - $\frac{3m}{4}$
 - $\frac{4}{3}m$
 - $\frac{3m}{5}$
 - none of these.

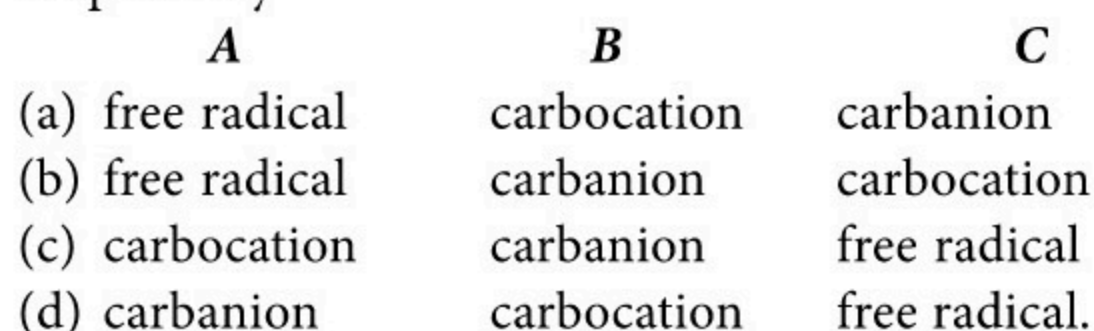
- Which of the following structures is enantiomeric with the molecule (I) given below?



- Which of the following statements is not correct?
 - $\text{K}[\text{PtCl}_3(\pi\text{-C}_2\text{H}_4)]$ Zeise's salt has a planar anion.
 - $[\text{Co}(\text{NH}_3)_3\text{Cl}_3]$ will not have optical isomers.
 - In optically active octahedral complex, $[\text{Fe}(\text{EDTA})]^{2-}$ coordination number of Fe is six.
 - $[\text{Co}(\text{NH}_3)_5\text{NO}_2]\text{Cl}$ and $\text{PtCl}_2 \cdot 4\text{NH}_3$ can be differentiated by AgNO_3 solution qualitatively.
- Consider the following bond cleavages,

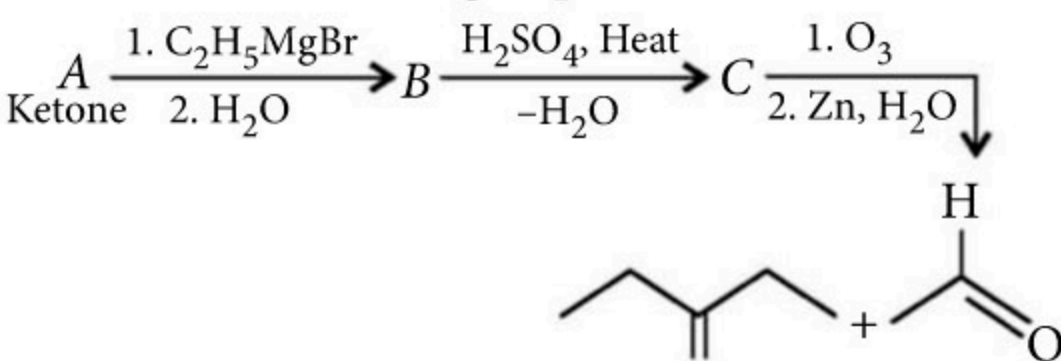
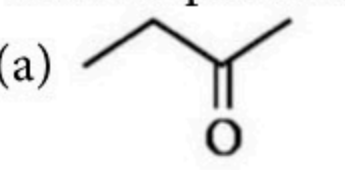
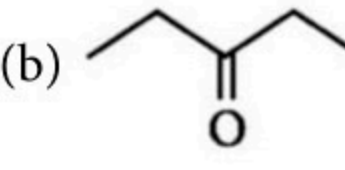
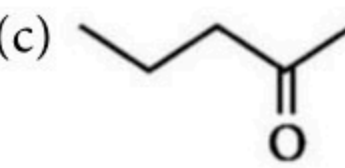
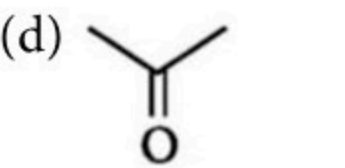
A. $\text{CH}_3-\text{X} \rightarrow \cdot\text{CH}_3 + \text{X}^-$; B. $\text{CH}_3-\text{X} \rightarrow \text{CH}_3^+ + \text{X}^-$; C. $\text{CH}_3-\text{X} \rightarrow \text{CH}_3^- + \text{X}^\cdot$

 Carbon species formed in A, B and C are respectively




9. The total number of gas molecules in a room of capacity 25 m^3 at a temperature of 27°C and 1 atm pressure will be
 (a) 3.011×10^{23} (b) 6.119×10^{23}
 (c) 6.119×10^{26} (d) 3.011×10^{26}
10. *iso*-propylamine cannot be obtained by
 (a) $(\text{CH}_3)_2\text{CO} + \text{NH}_2\text{OH} \xrightarrow{\text{LiAlH}_4} ?$
 (b) $(\text{CH}_3)_2\text{CO} + \text{NH}_3 \xrightarrow{\Delta} ? \xrightarrow{\text{H}_2/\text{Ni}}$
 (c) $\begin{array}{c} \text{CH}_3 \\ \diagup \\ \text{CH} - \text{Br} \\ \diagdown \\ \text{CH}_3 \end{array} + \text{NaNH}_2 \longrightarrow$
 (d) $\begin{array}{c} \text{CH}_3 \\ \diagup \\ \text{CHOH} \\ \diagdown \\ \text{CH}_3 \end{array} + \text{NH}_3 \xrightarrow{\text{Al}_2\text{O}_3, 633\text{K}}$
11. Which of the following order is incorrect for the indicated property?
 (a) $\text{BeO} < \text{MgO}$ – Basic strength
 (b) $\text{BeF}_2 < \text{MgF}_2 < \text{CaF}_2 < \text{SrF}_2 < \text{BaF}_2$ – Solubility
 (c) $\text{SO}_2 > \text{SeO}_2 > \text{TeO}_2$ – Acidic strength
 (d) $\text{NaCl} > \text{KCl} > \text{RbCl} > \text{CsCl}$ – Melting point
12. The structural formula of monomer of polymethyl methacrylate (PMMA) is
 (a) $\text{CH}_2 = \text{CHCOOCH}_3$
 (b) $\begin{array}{c} \text{CH}_3 \\ | \\ \text{CH}_2 = \text{C} - \text{COOCH}_3 \end{array}$
 (c) $\text{CH}_3\text{COOCH} = \text{CH}_2$
 (d) $\begin{array}{c} \text{CH}_3 \\ | \\ \text{CH}_3\text{COOC} = \text{CH}_2 \end{array}$
13. When electronic transition occurs from higher energy state to a lower energy state, with energy difference equal to ΔE (eV), the wavelength of line emitted is approximately equal to
 (a) $\frac{12400}{\Delta E} \times 10^{-10} \text{ m}$ (b) $\frac{13397}{\Delta E} \times 10^{10} \text{ m}$
 (c) $\frac{14322}{\Delta E} \times 10^{-10} \text{ cm}$ (d) $\frac{12387}{\Delta E} \times 10^{10} \text{ cm}$
14. The correct statement regarding defects in crystalline solids is
 (a) Frenkel defects decrease the density of crystalline solids
 (b) Frenkel defect is a dislocation defect
 (c) Frenkel defect is found in halides of alkaline metals
 (d) Schottky defects have no effect on the density of crystalline solids.
15. Consider the following reaction,

$$x\text{MnO}_4^- + y\text{C}_2\text{O}_4^{2-} + z\text{H}^+ \rightarrow x\text{Mn}^{2+} + 2y\text{CO}_2 + \frac{z}{2}\text{H}_2\text{O}$$
 The values of x , y and z in the reaction are respectively
 (a) 2, 5 and 16 (b) 5, 2 and 16
 (c) 5, 2 and 8 (d) 2, 5 and 18
16. Specific conductance of 0.1 M CH_3COOH at 25°C is $3.9 \times 10^{-4} \text{ ohm}^{-1} \text{ cm}^{-1}$. If $\lambda^\infty_{(\text{H}^+)}$ and $\lambda^\infty_{(\text{CH}_3\text{COO}^-)}$ at 25°C are 349.0 and $41.0 \text{ ohm}^{-1} \text{ cm}^2 \text{ mol}^{-1}$ respectively, degree of ionisation of CH_3COOH at the given concentration is
 (a) 2.0% (b) 1.0% (c) 4.0% (d) 5.0%
17. The standard internal energy change during the course of reaction at equilibrium at 300 K,
 $2\text{A}_{(\text{g})} + \text{B}_{(\text{g})} \rightleftharpoons \text{A}_2\text{B}_{(\text{g})}$ is
 (Given, $K_p = 10^{-10} \text{ atm}^{-2}$ and $\Delta S = 5 \text{ J K}^{-1}$)
 (a) -63.93 kJ (b) $+63.93 \text{ kJ}$
 (c) $+58.94 \text{ kJ}$ (d) -58.94 kJ
18. Consider the following sequence of reactions,

$$\text{Ketone (A)} \xrightarrow[2. \text{H}_2\text{O}]{1. \text{C}_2\text{H}_5\text{MgBr}} \text{B} \xrightarrow[-\text{H}_2\text{O}]{\text{H}_2\text{SO}_4, \text{Heat}} \text{C} \xrightarrow[2. \text{Zn, H}_2\text{O}]{1. \text{O}_3} \text{HCHO}$$

 The compound (A) is
 (a)  (b) 
 (c)  (d) 
19. For the equilibrium of the reaction,


$$\text{HgO}_{(\text{s})} \rightleftharpoons \text{Hg}_{(\text{g})} + \frac{1}{2}\text{O}_{2(\text{g})}$$
 K_p at total pressure P is



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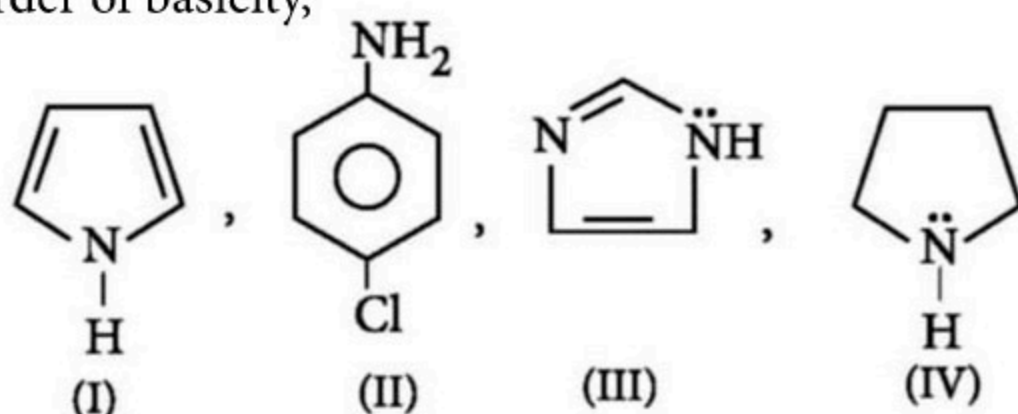
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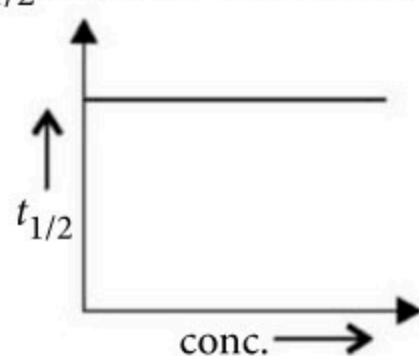
- (a) $\frac{2}{3^{3/2}} P^{3/2}$ (b) $\frac{2}{3^{1/2}} P^{1/2}$
 (c) $\frac{1}{3^{2/3}} P^{3/2}$ (d) $\frac{2}{3^{2/3}} P$

20. Arrange the following according to their increasing order of basicity,



- (a) I < II < III < IV (b) IV < III < II < I
 (c) I > II < III > IV (d) None of these

21. The plot of $t_{1/2}$ vs conc. of reactant is shown below :



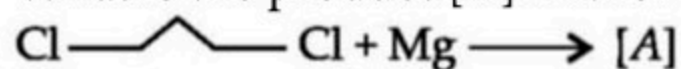
The order of reaction is


- (a) 0 (b) 1 (c) 2 (d) 3

22. An inorganic compound (X) which produces brick red colouration in flame. When (X) dissolves in water produces alkaline solution and a combustible gas (Y). (X) and (Y) are respectively

- (a) CaO, O₂ (b) Ca₃N₂, NH₃
 (c) CaCO₃, CO₂ (d) CaH₂, H₂

23. What is the product [A] in the following reaction?

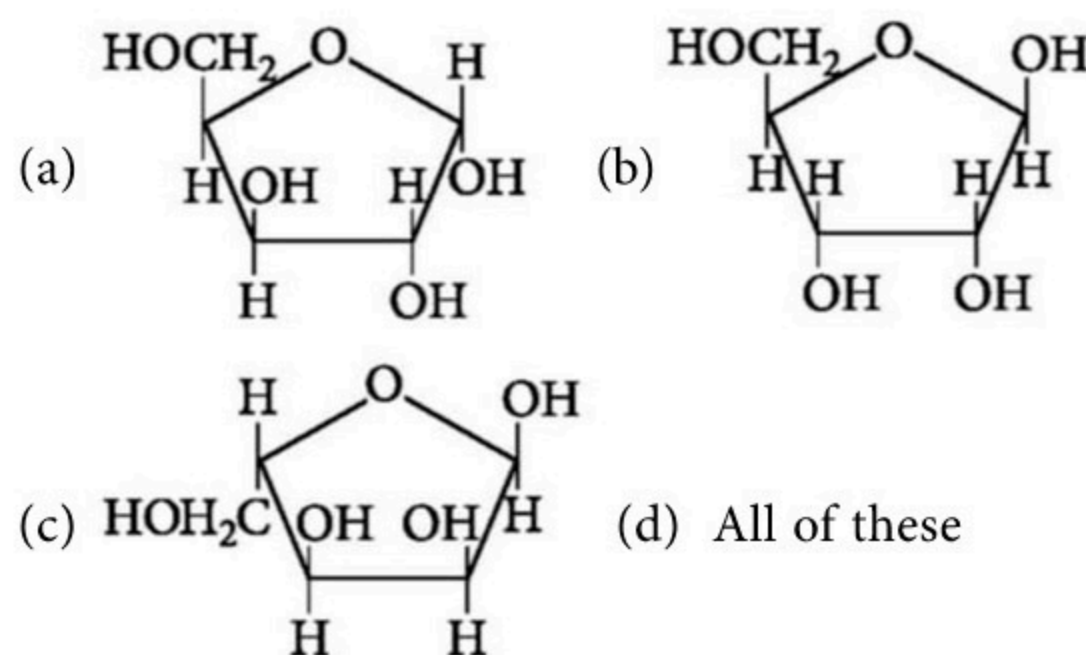
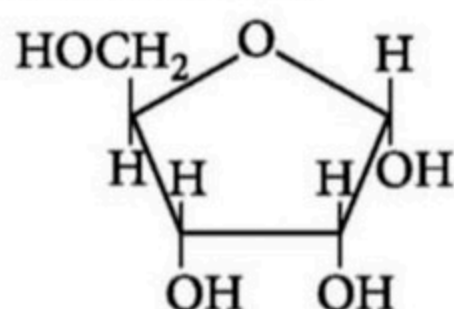


- (a) 
 (b) Cl-Mg-CH2-CH2-CH2-Mg-Cl
 (c) Both (a) and (b)
 (d) None of these

24. How does H₂O₂ differ from O₃ in its chemical action?

- (a) In oxidising PbS to PbSO₄
 (b) In liberating I₂ from KI
 (c) In decolourising acidified KMnO₄
 (d) In oxidising K₄[Fe(CN)₆] to K₃[Fe(CN)₆]

25. Which of the following represents the anomer of the compound shown below?



26. Ibuprofen tablets sold in the market contain
 (a) only S-enantiomer (b) only R-enantiomer
 (c) racemic mixture of both R- and S-enantiomers
 (d) both R and S enantiomers are active pain hypnotic.

27. Which of the following electronic configurations will have the highest electron gain enthalpy?

- (a) [Ar]3d¹⁰4s²4p¹ (b) [Ar]3d¹⁰4s²4p⁴
 (c) [Ar]3d¹⁰4s²4p⁵ (d) [Ar]3d¹⁰4s²4p³

28. Potassium stearate is obtained by saponification of an oil or fat. It has formula, CH₃(CH₂)₁₆COO⁻K⁺.

The molecule has a hydrophobic end CH₃(CH₂)₁₆— and a hydrophilic end COO⁻K⁺. Potassium stearate is an example of

- (a) lyophobic colloid
 (b) multimolecular colloid
 (c) macromolecular colloid
 (d) associated colloid or micelle.

29. Which of the following statement is correct?

- (a) NO is more harmful than NO₂.
 (b) SO₂ is more harmful than SO₃.
 (c) Acid rain contains mainly HNO₃.
 (d) Acid rain contains mainly H₂SO₄ and lesser concentrations of HNO₃ and HCl.

30. Sulphide ores of metals are usually concentrated by froth floatation process. Which one of the following sulphide ores offers an exception and is concentrated by chemical leaching?

- (a) Galena (b) Copper pyrite
 (c) Sphalerite (d) Argentite

CATEGORY-II (Q. 31 to Q. 35)

Carry 2 marks each and only one option is correct. In case of incorrect answer or any combination of more than one answer, 1/2 mark will be deducted.

31. Which of the following order is correct?


- (a) Si—Si > C—C > Ge—Ge; Bond energy
 (b) H—H > F—F > C—C; Bond energy





- (c) $\text{Ge} < \text{Sn} < \text{Pb}$; Ability of ns^2e^- to participate in bonding
 (d) $\text{SiH}_4 > \text{SnH}_4 > \text{PbH}_4 > \text{CH}_4$; ease of hydrolysis

32. Conductance of 0.1 M KCl; conductivity = $x \text{ ohm}^{-1} \text{ cm}^{-1}$ filled in a conductivity cell is $y \text{ ohm}^{-1}$. If the conductance of 0.1 M NaOH filled in the same cell is $z \text{ ohm}^{-1}$, molar conductance of NaOH will be

- (a) $0.1 \frac{xz}{y}$ (b) $10 \frac{xz}{y}$ (c) $10^3 \frac{xz}{y}$ (d) $10^4 \frac{xz}{y}$

33. Of the ions Zn^{2+} , Ni^{2+} and Cr^{3+} ,
 (At. nos. $\text{Zn} = 30$, $\text{Ni} = 28$, $\text{Cr} = 24$)
 (a) only Zn^{2+} is colourless and Ni^{2+} and Cr^{3+} are coloured
 (b) all three are colourless
 (c) all three are coloured
 (d) only Ni^{2+} is coloured and Zn^{2+} and Cr^{3+} are colourless.

34. When  undergoes dehydration reaction in presence of concentrated H_2SO_4 then what will be the major product?

- (a)  (b) 
 (c)  (d) 

35. Which of the following is paramagnetic complex?
 (a) Tetracyanonickelate(II) ion
 (b) Tetraamminezinc(II) ion
 (c) Hexaamminechromium(III) ion
 (d) Diamminesilver(I) ion

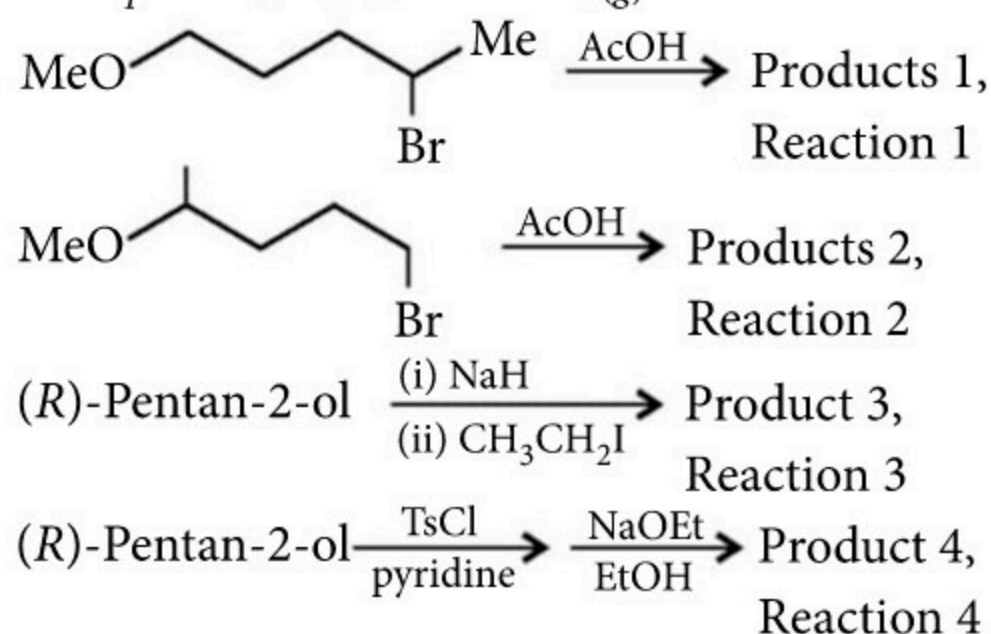
CATEGORY-III (Q. 36 to Q. 40)

Carry 2 marks each and one or more option(s) is/are correct. If all correct answers are not marked and also no incorrect answer is marked then score = $2 \times$ number of correct answers marked \div actual number of correct answers. If any wrong option is marked or if any combination including a wrong option is marked, the answer will be considered wrong, but there is no negative marking for the same and zero marks will be awarded.

36. A first order reaction has $k = 1.5 \times 10^{-6}$ per second at 200°C . If the reaction is allowed to take place for 10 hours, what percentage of the initial concentration would have changed into product?
 (a) 5.26% (b) 6.26% (c) 7.26% (d) 8.26%

37. Which of the following are correct statements?
 (a) β -Ketoacids decarboxylate faster than α -keto acids.
 (b) Succinic acid on heating will form cyclic anhydride.
 (c) 2-Hydroxy butanoic acid on heating will form but-2-enoic acid.
 (d) Benzoic acid is stronger acid than formic acid.

38. 138 g of $\text{N}_2\text{O}_4(\text{g})$ is placed in 8.2 L container at 300 K. The equilibrium vapour density of mixture was found to be 30.67. Then
 (a) the total pressure at equilibrium = 4.5 atm
 (b) the degree of dissociation of $\text{N}_2\text{O}_5 = 0.25$
 (c) the total number of moles at equilibrium is 1.5
 (d) K_p of $\text{N}_2\text{O}_4 \rightleftharpoons 2\text{NO}_2(\text{g})$ will be 6 atm.

39. 

Which of the following statement(s) is(are) correct?

(a) Products 1 and products 2 are same.
 (b) Products 1 and products 2 are different.
 (c) Product 3 will have R and product 4 will have S-configuration.
 (d) Product 3 will have S and product 4 will have R-configuration.

40. $\text{Pb}_{(\text{s})} + \text{HgCl}_{2(\text{aq})} \longrightarrow \text{PbCl}_{2(\text{aq})} + \text{Hg}_{(\text{l})}$
 $\left(\frac{dE}{dT}\right)_p = 1.5 \times 10^{-4} \text{ V K}^{-1}$ at 298 K
 The change in entropy in $\text{J K}^{-1} \text{ mol}^{-1}$ for the cell reaction is
 (a) 14.475 (b) 28.95 (c) 57.9 (d) 86.82

WB JEE Practice Paper 2020

ANSWER KEY

- | | | | |
|-------------|-------------|-----------|---------|
| 1. (a) | 2. (c) | 3. (b) | 4. (d) |
| 5. (a) | 6. (a) | 7. (d) | 8. (a) |
| 9. (c) | 10. (c) | 11. (b) | 12. (b) |
| 13. (a) | 14. (b) | 15. (a) | 16. (b) |
| 17. (b) | 18. (b) | 19. (a) | 20. (d) |
| 21. (b) | 22. (d) | 23. (a) | 24. (c) |
| 25. (b) | 26. (c) | 27. (c) | 28. (d) |
| 29. (d) | 30. (d) | 31. (d) | 32. (d) |
| 33. (a) | 34. (d) | 35. (c) | 36. (a) |
| 37. (a,b,c) | 38. (a,c,d) | 39. (a,c) | 40. (b) |



CONCEPT BOOSTER

Hello boys and girls!! Wish you all a very happy new year. I believe this year will bring prosperity to you all. My suggestion to you is try to be imperturbable while preparing for the exam as well as while giving the exam. Your anxiety and panic will bring incongruity between your knowledge and performance. I have always suggested you that try to complete the basics first and then go to the unconventional parts. After this do rigorous practice. I believe this will bring success and success. Good luck. This article with an unconventional but important topic will make you feel confident.

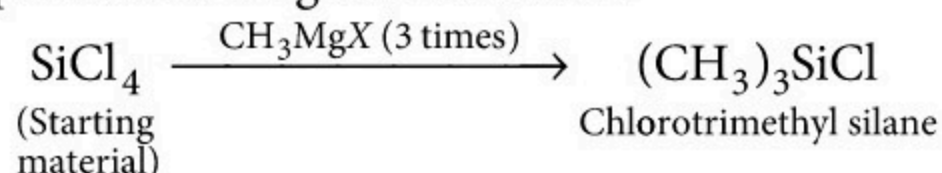
*Arunava Sarkar

ORGANOSILICON COMPOUNDS

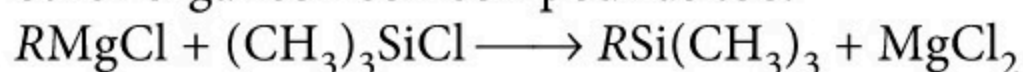
These are very useful reagents in a number of organic synthesis. Most commonly used such reagents are chlorotrialkyl silanes like Me_3SiCl (chlorotrimethyl silane) or Et_3SiCl (chlorotriethyl silane) etc. These reagents are used mostly as protecting groups, stabilisation of carbocations, carbanions etc. On the other hand, we have silicon hydrides like triethyl silane (Et_3SiH) which are used as reducing agents and specially to reduce alkenes and carbonyl compounds.

Short Method of Preparation of organosilicon compounds

A short outline of the preparation of organosilicon compound can be given as below :



Taking $(\text{CH}_3)_3\text{SiCl}$ as a starting material we can prepare other organosilicon compounds too.



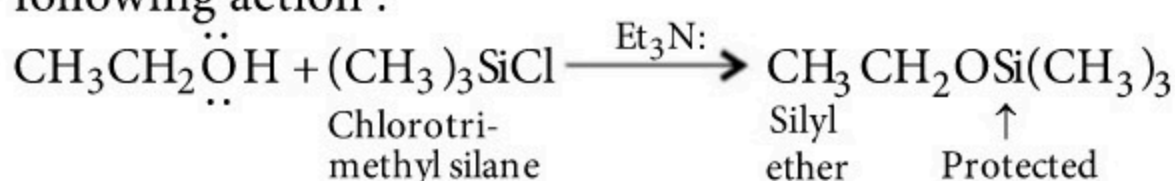
R can be suitable group including any allylic group like $\text{RCH}_2 - \text{CH} = \text{CH} -$, etc.

Now, let us be specific about the reagents and their functions.

Chlorotrialkyl silane

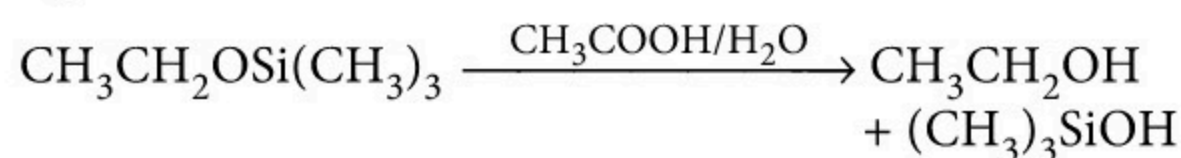
Function 1 : As a protecting group for alcohols, amines, thioalcohols and terminal alkynes.

Let us take ethyl alcohol ($\text{C}_2\text{H}_5\text{OH}$). Here, the reactive part is the hydrogen atom of the $-\text{O}-\text{H}$ group. So, if we wish to protect the $-\text{OH}$ group we can take the following action :

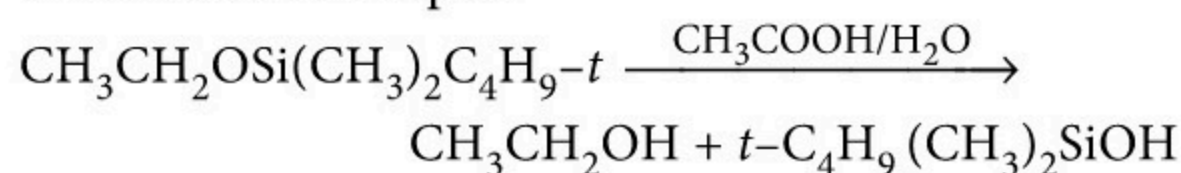


In this type of reaction the order of reactivity of alcohols is $1^\circ > 2^\circ > 3^\circ$ (alkyl alcohols) and alkyl alcohols $>$ phenols or phenolic derivatives.

Silyl ether thus obtained can be cleaved with aqueous acid or base or sometimes even under some normal aqueous conditions.



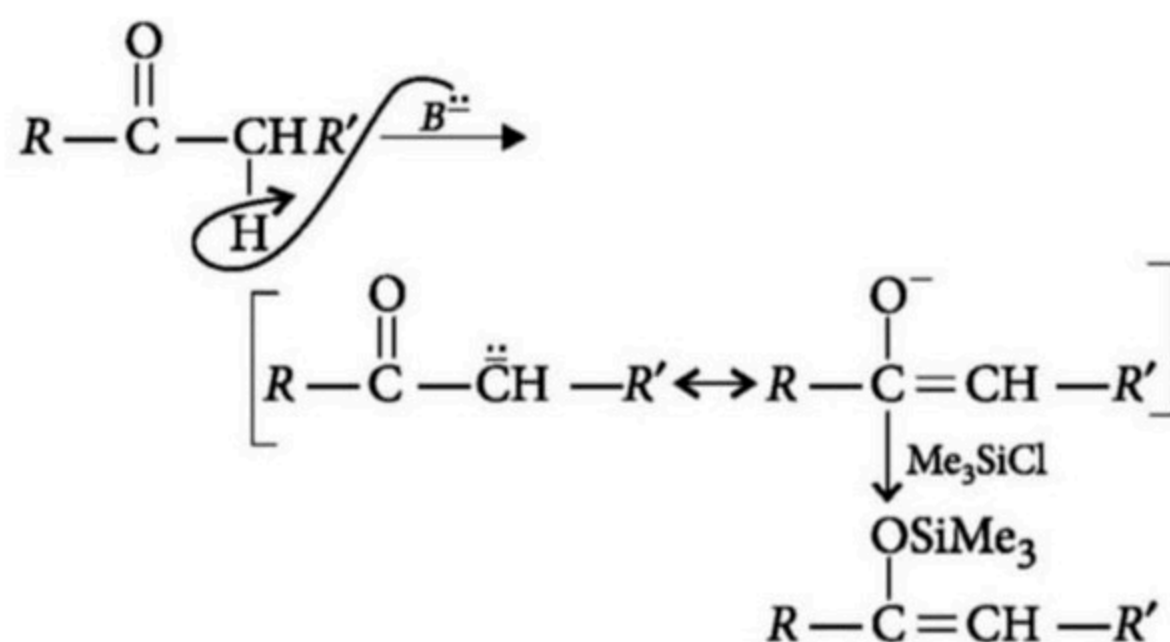
Take another example :



There is another way by which the deprotection of silyl ether can be done and that is fluoride ion. Such fluoride ion can be obtained from HF, KF or ammonium fluoride salt. Actually, Si — F bond is stronger bond than Si — O bond. This is the driving force for the readily cleavage of Si — O bond by F^- in order to produce Si — F bond.

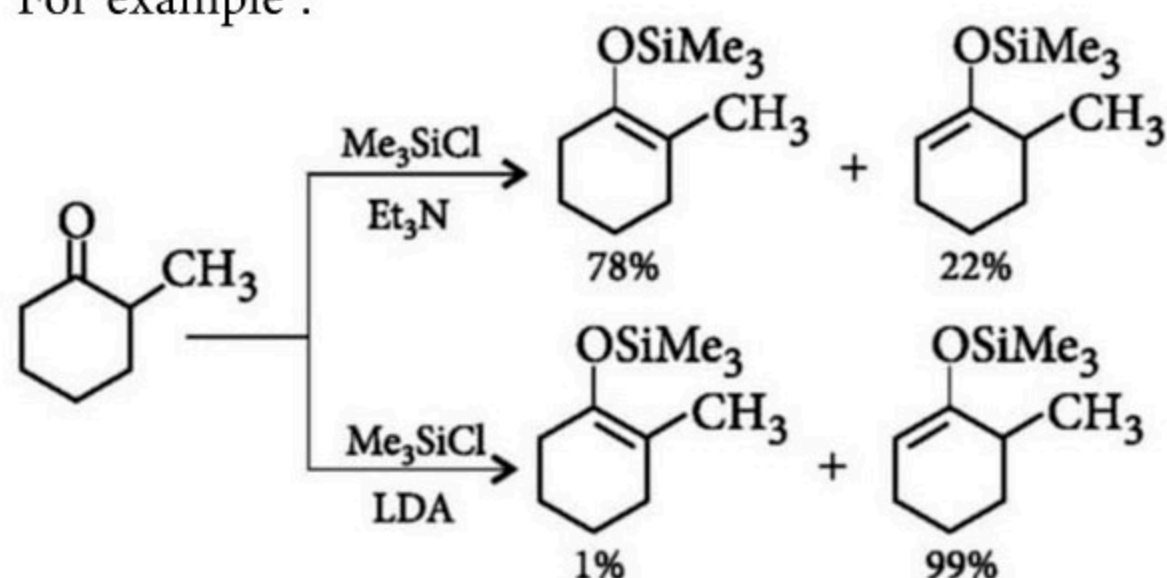
Function 2 : Reaction with enolates :

Let us see at first how a chlorotrimethyl silane reacts with an enolate :

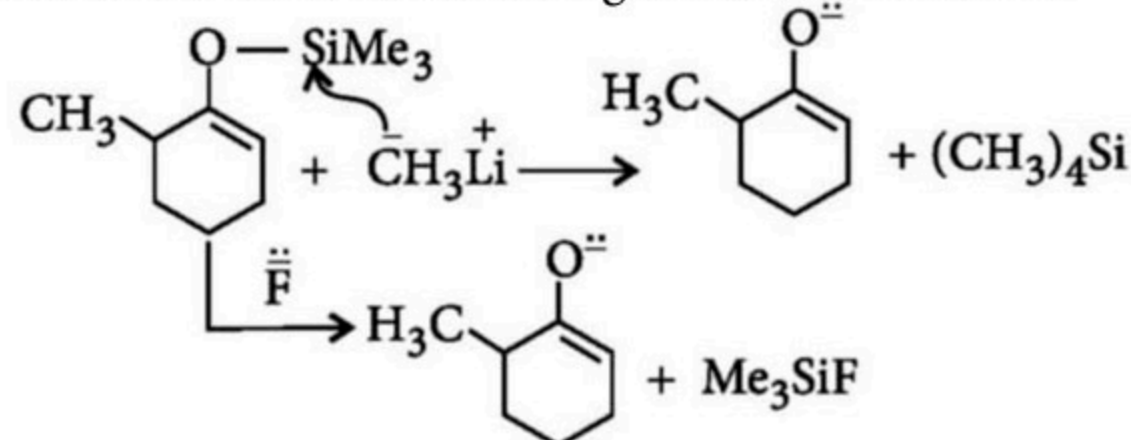


Now, amount of product in such cases depends on the kind of base being used.

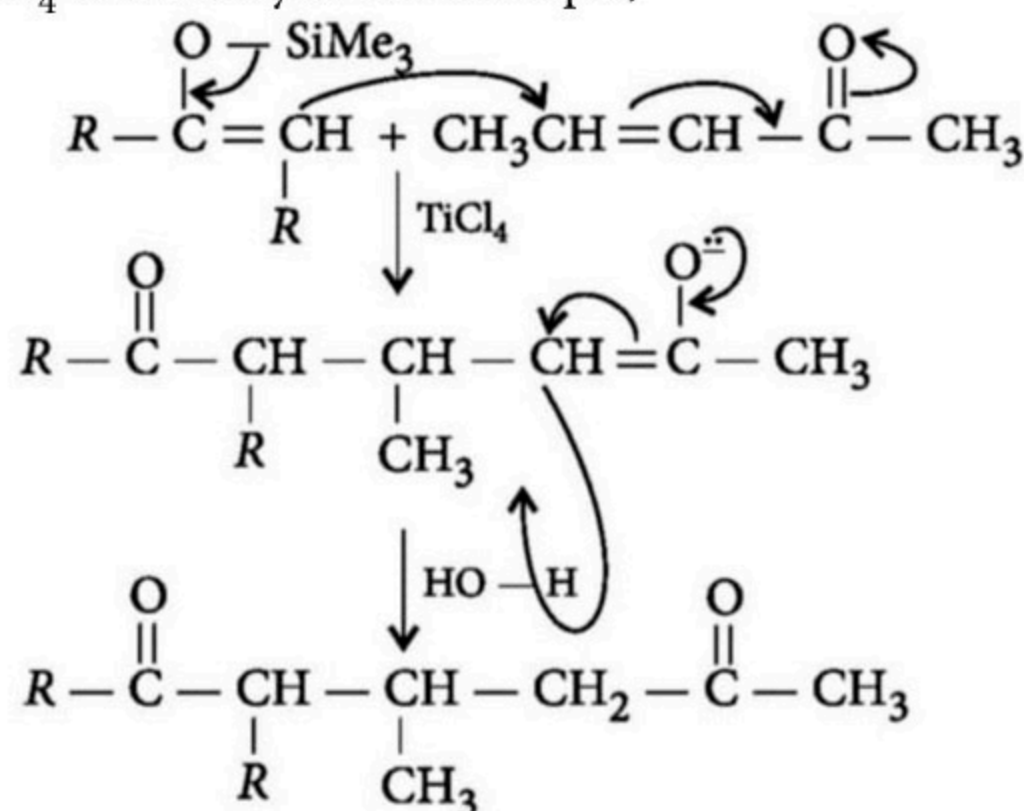
For example :



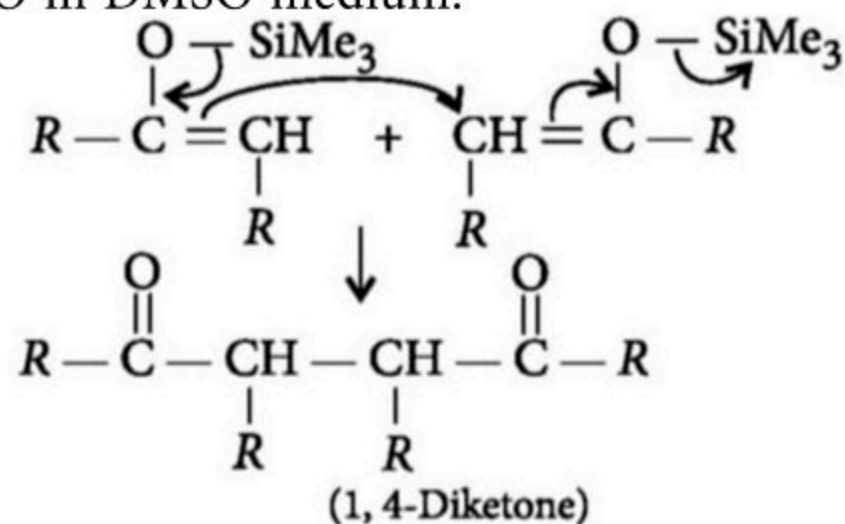
LDA is a bulky base, so gives kinetically controlled enolate but Et_3N gives thermodynamically controlled enolate. Here, the silyl enol ethers undergo reaction with methyl lithium or fluoride ion to regenerate the enolates.



With α, β -unsaturated compounds, silyl ethers of enols add to yield Michael addition product in presence of TiCl_4 as a catalyst. For example,

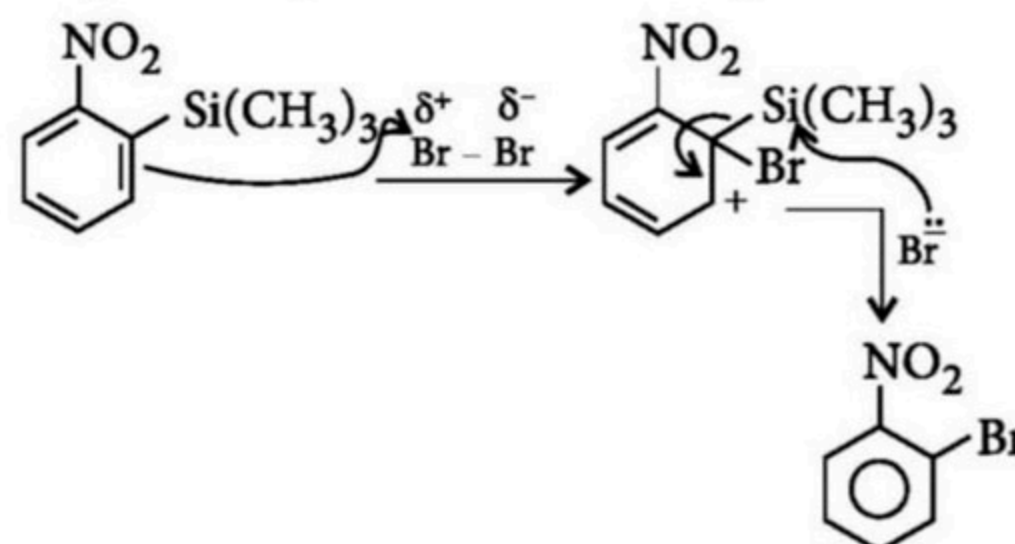


Silyl ethers also can undergo dimerisation in presence of Ag_2O in DMSO medium.

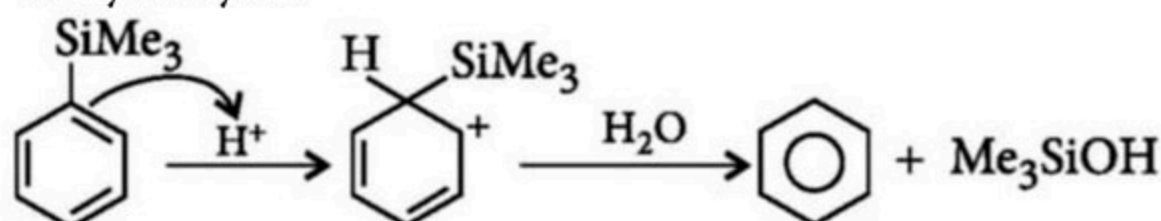


Function 3 : Ipso substitution :

Silicon has a vacant d orbital and it can undergo hyperconjugation with carbon atom so, it can stabilise a nearby carbocation. When an electrophile attacks the carbon atom bearing the trimethylsilyl group, then the trimethylsilyl group is replaced by the incoming electrophile. As you know this is an ipso-substitution.



Ipso substitution can also take place during the course of hydrolysis.

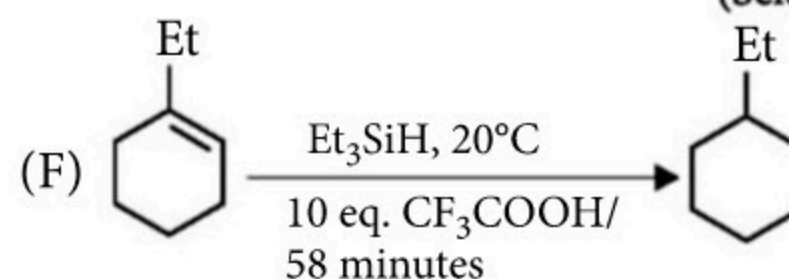
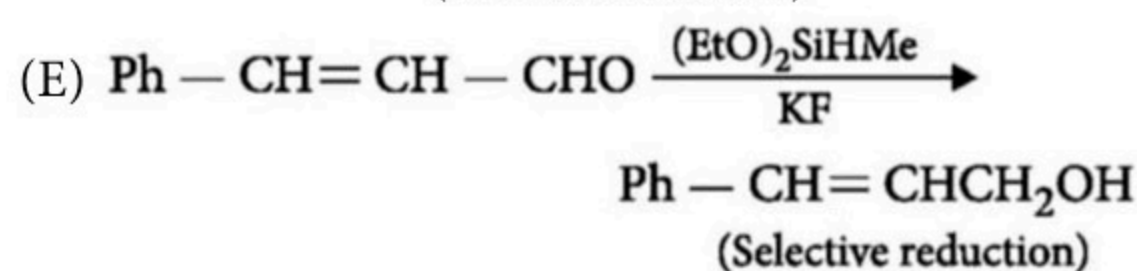
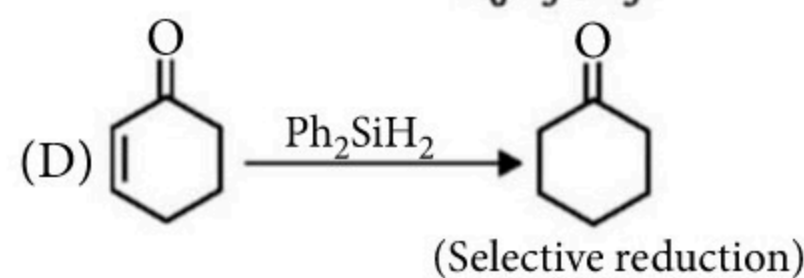
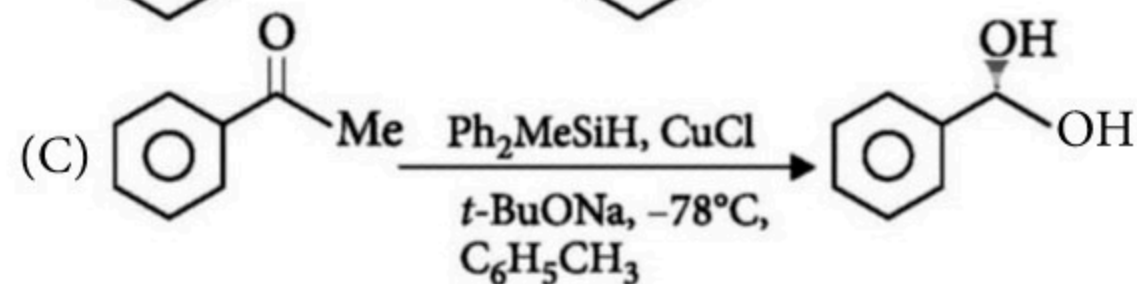
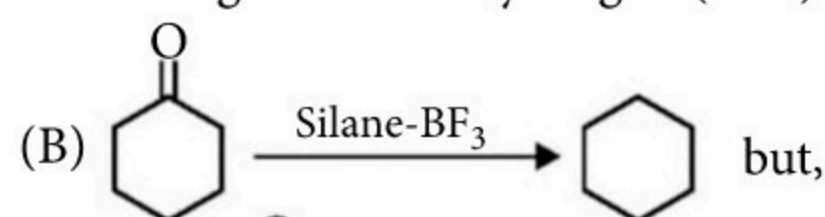


Function 4 : Reduction by silanes :

For selective reductions silanes are very useful. Some specific examples are given below :



Remember, Si (Electronegativity = 1.9) is less electronegative than hydrogen (2.20).



EXAM READY GET SET GO

Exams are not mysterious, hit or miss affairs. With the right kind of preparation you can maximize your chances of doing well.

There are 2 main types of things you need to demonstrate in the exam :

- (i) Knowledge of the topics – you need to develop your memory.
- (ii) Skills of the historian – you need to use sources in an efficient way.

WHAT TO DO?

- Do your very best to get specimen papers/ previous solved papers and to make sure that you know the exact format of the exam and the kinds of questions asked in the exam.
- Decide how much of the syllabus you need to cover so that you can safely answer enough questions. But make sure you read every topic at least once.
- Keep some “Recap slots” so that you can spend extra time on harder topics, review what you have already learnt, or catch up if you have fallen behind.
- Reduce the bulk of your notes down to key ideas.
- Make question banks and summaries.
- To develop memory, work out how the course is organised and make a revision plan that reflects this. Try to plan in time to do all the topics more than once, rather than saying “I’ll revise everything once really well”
- Learn how to use new strategies for learning, remembering, and thinking.
- Join or form a study group to practice multiple choice questions of various levels.
- Study old question papers and examine each question to determine :
 - the level or type of thinking required
 - the degree of difference between incorrect and correct alternatives.

Attempting multiple choice exams

- Read the stem with each alternative to take advantage of the correct sound or flow that the correct answer often produces. Also, you can eliminate any alternative that does not agree grammatically with the stem.
- Consider “all of the above” and “none of the above.” Examine the “above” alternatives to see if all of them or

none of them apply totally. If even one does not apply totally, do not consider “all of the above” or “none of the above” as the correct answer. Make sure that a statement applies to the question since it can be true, but not be relevant to the question at hand!

- **Note negatives** : If a negative such as “none”, “not”, “never”, or “neither” occurs in the stem, know that the correct alternative must be a fact or absolute and that the other alternatives could be true statements, but not the correct answer.
- **Note superlatives** : Words such as “every”, “all”, “none”, “always”, and “only” are superlatives that indicate the correct answer must be an undisputed fact.
- **Note qualifying words** : “Usually”, “often”, “generally”, “may”, and “seldom” are qualifiers that could indicate a true statement.
- Use your knowledge of headings to think about where in your text, lecture notes, lab, etc. that question is drawn from. Recall a few salient points about the information. If necessary, jot down any relevant facts you need to process the alternatives. This does not have to take much time but this recall is an essential step!
- If you were unable to make a choice and need to spend more time with the question, or you answered the question but are not at all sure that you made the correct choice, put a big question mark beside that question, and move on to the next. Avoid getting bogged down on one question part of the way through the exam. It is much better to move on and finish all those questions that you can answer and then to come back later to process the problematic questions.
- Don’t dismiss an alternative because it seems too obvious and simple to answer. If you are well prepared for the exam, some of the questions will appear very straightforward to you.
- Don’t pick your answer based on a pattern of responses, i.e., don’t say to yourself, “This can’t be another “b” answer as we have just had three in a row.”



CHEMISTRY MUSING

SOLUTION SET 77

1. (a): $A_{(g)} \rightleftharpoons B_{(g)} + 2C_{(g)}$ and $C_{(g)} \rightleftharpoons 2D_{(g)} + 3B_{(g)}$

1	0	0			
$1 - a$	$(a + 3b)$	$2a - b$	$2a - b$	$2b$	$(a + 3b)$

\therefore Total number of moles at equilibrium = $1 - a + a + 3b + 2a - b + 2b = 2a + 4b + 1$

Now, $P_{\text{initial}} \propto 1$; $P_{\text{eq}} \propto 2a + 4b + 1$

$\therefore 2a + 4b + 1 = \frac{13}{6}$ or $2a + 4b = \frac{7}{6}$... (i)

Also, $[C]_{\text{eq}} = \frac{4}{9} [A]_{\text{eq}}$

$2a - b = \frac{4}{9} \times (1 - a)$; $22a - 9b = 4$... (ii)

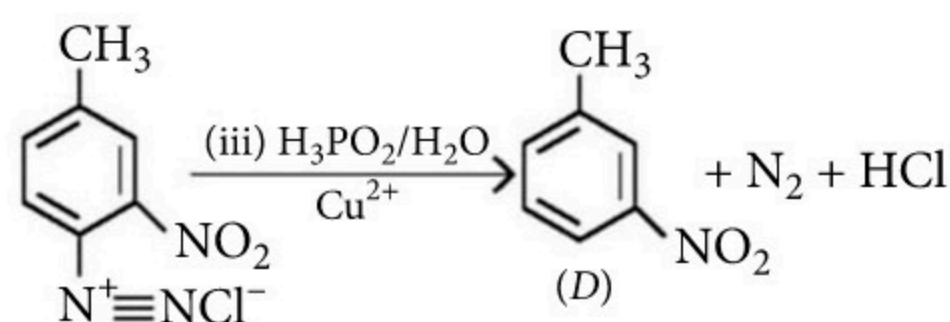
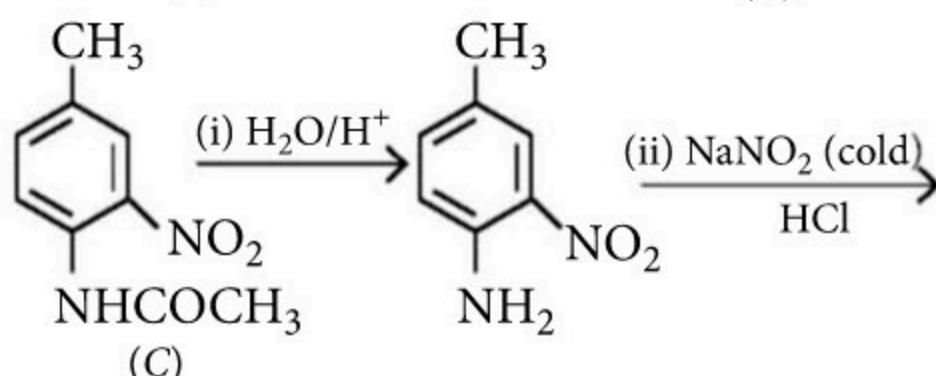
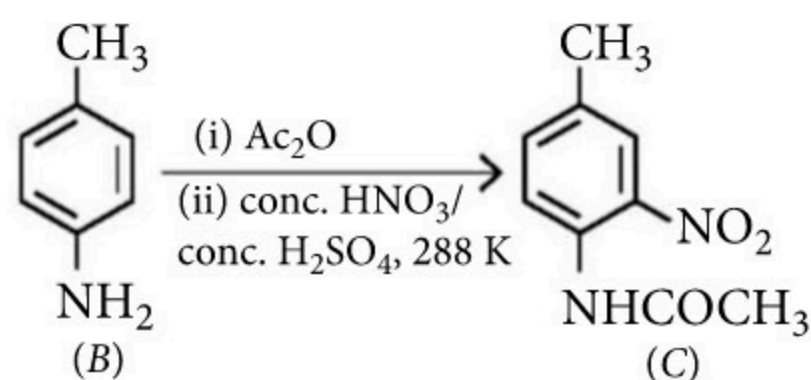
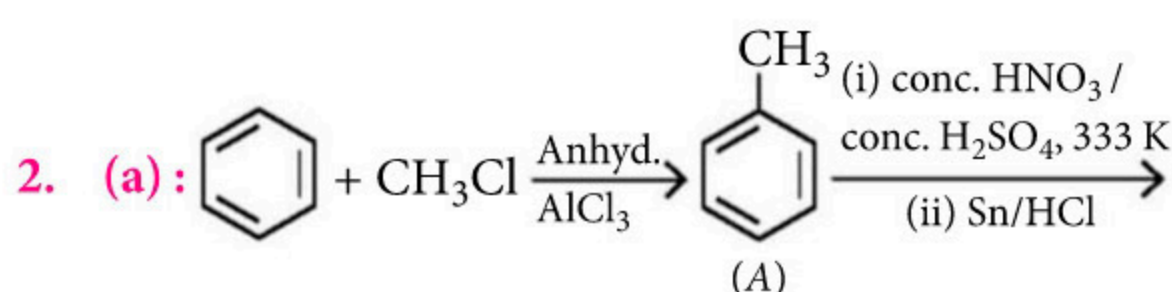
From equations (i) and (ii), $a = 0.25$, $b = 0.167$

$\therefore K_{C_1} = \frac{[B][C]^2}{[A]} = \frac{(a + 3b)(2a - b)^2}{(1 - a)}$

$$= \frac{[0.25 + (3 \times 0.167)][0.5 - 0.167]^2}{(1 - 0.25)} = 0.11$$

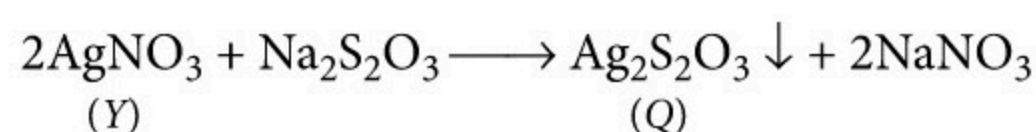
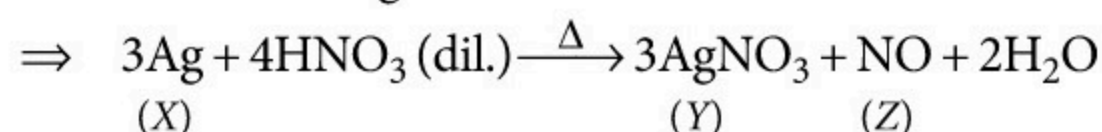
$\therefore K_{C_2} = \frac{[D]^2[B]^3}{[C]} = \frac{(2b)^2(a + 3b)^3}{(2a - b)}$

$$= \frac{[2 \times 0.167]^2 [0.25 + (3 \times 0.167)]^3}{[0.5 - 0.167]} = 0.14$$

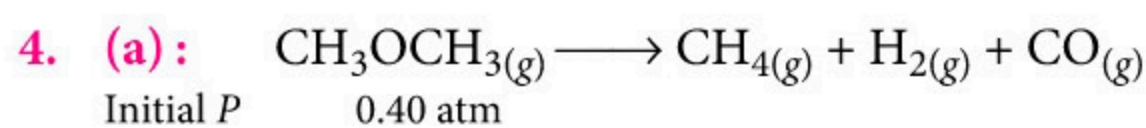
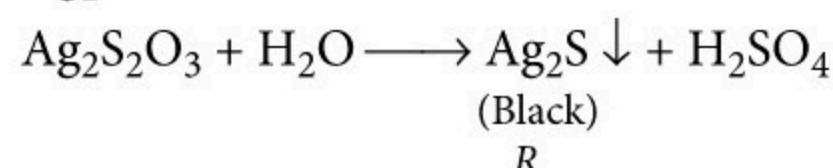


3. (c): Since (Y) on treatment with brine solution gave a white ppt. (P), hence (P) is AgCl.

\Rightarrow Metal X = Ag



$\text{Ag}_2\text{S}_2\text{O}_3$ on standing forms a black precipitate of Ag_2S .



Initial P 0.40 atm

At $t = 12$ min. $(0.40 - P)$ P P P

For ideal gas behaviour, Mole \propto Pressure

(at constant V and T)

Let 'a' be the initial moles (here in terms of pressure) of CH_3OCH_3 .

$\therefore a \propto 0.40$; $(a - x) \propto (0.40 - P)$

$k = \frac{2.303}{t} \log_{10} \frac{a}{a - x}$

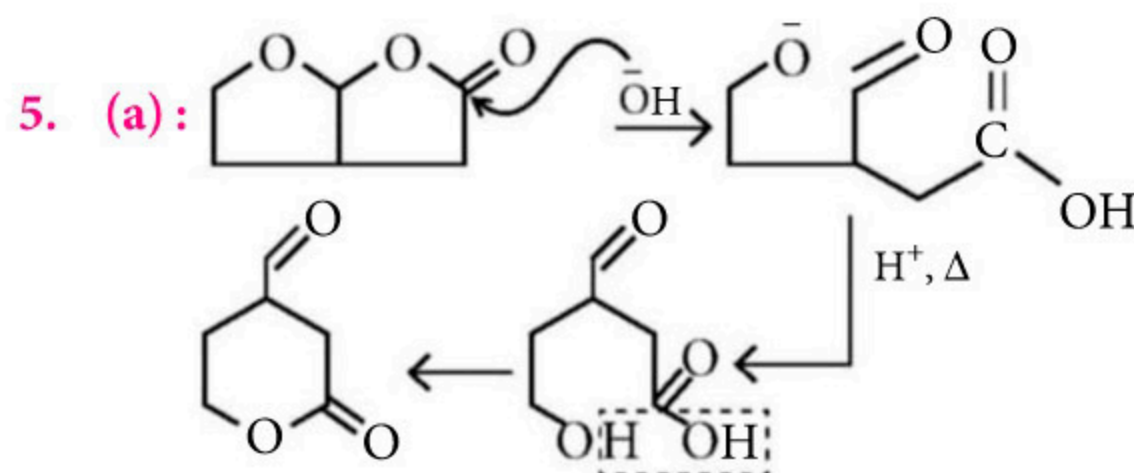
$\frac{0.693}{14.5} = \frac{2.303}{12} \log_{10} \frac{0.40}{(0.40 - P)} \quad \left[\because k = \frac{0.693}{t_{1/2}} \right]$

$\therefore P = 0.175$ atm

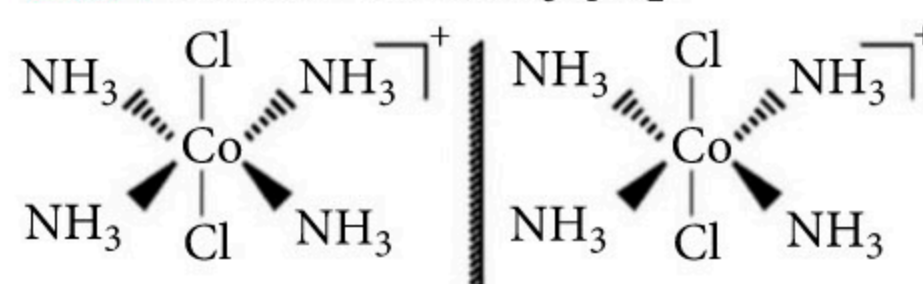
Now, total pressure after 12 minutes

$= 0.40 - P + P + P + P$

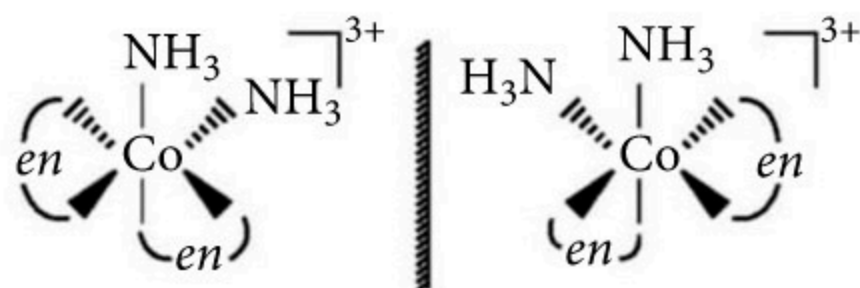
$= 0.40 + 2P = 0.40 + 2 \times 0.175 = 0.75$ atm



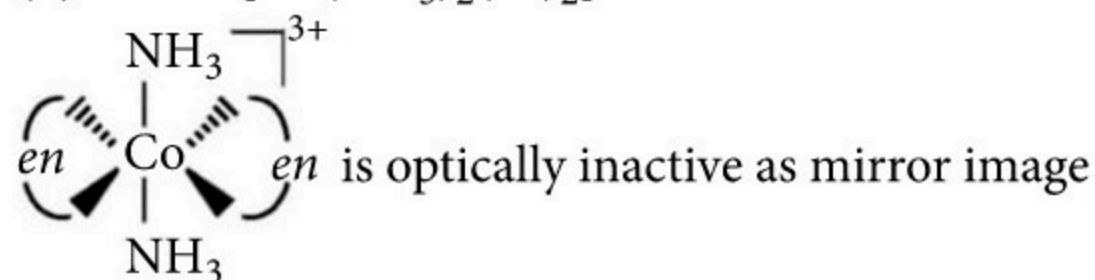
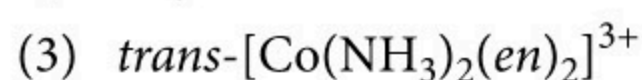
6. (b,d): (1) $\text{trans}-[\text{Co}(\text{NH}_3)_4\text{Cl}_2]^+$



Mirror images are identical, therefore, optically inactive.

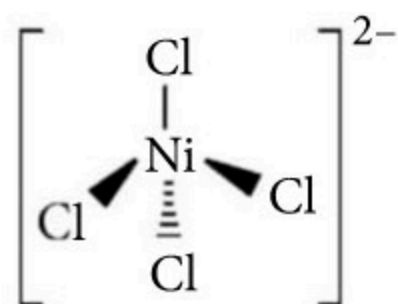


Mirror images are non-superimposable. Hence, optically active.



will be superimposable.

(4) $[\text{NiCl}_4]^{2-}$ is a tetrahedral complex. It is symmetrical and hence, optically inactive.

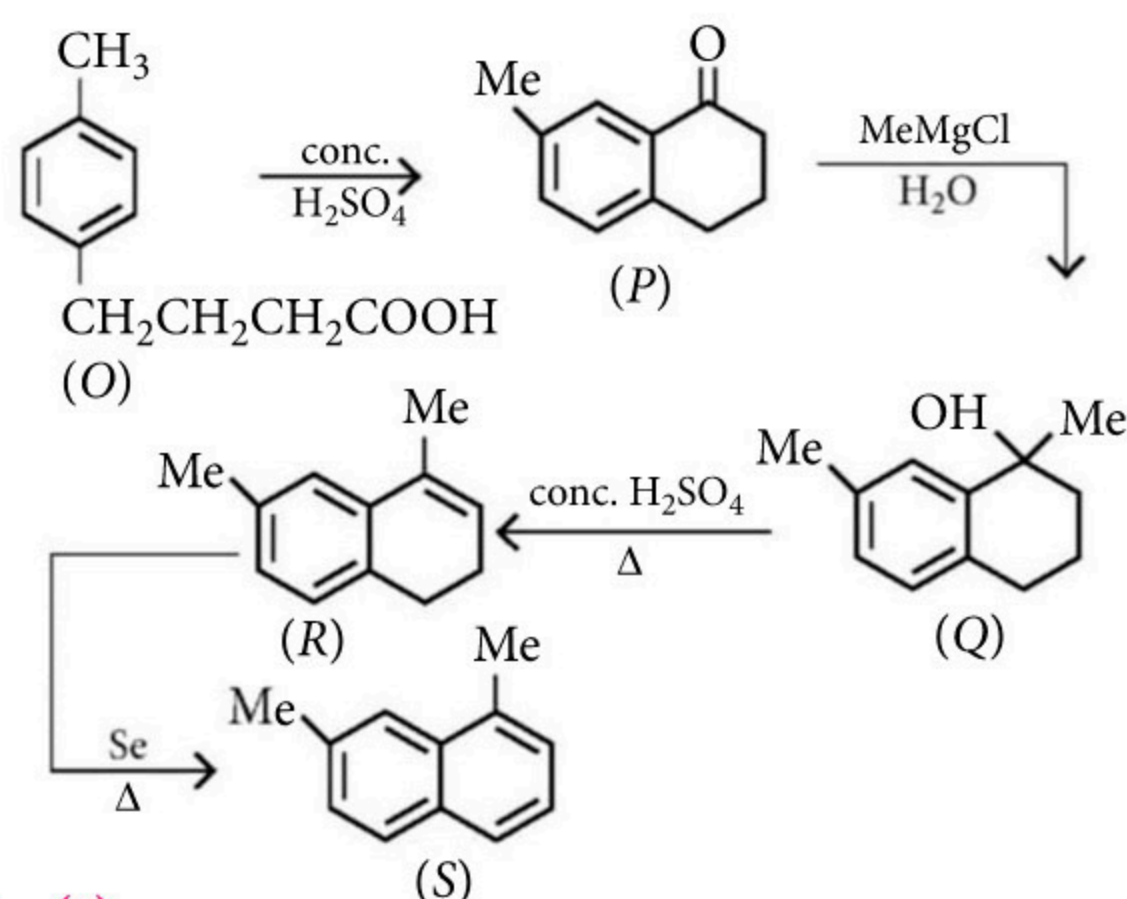
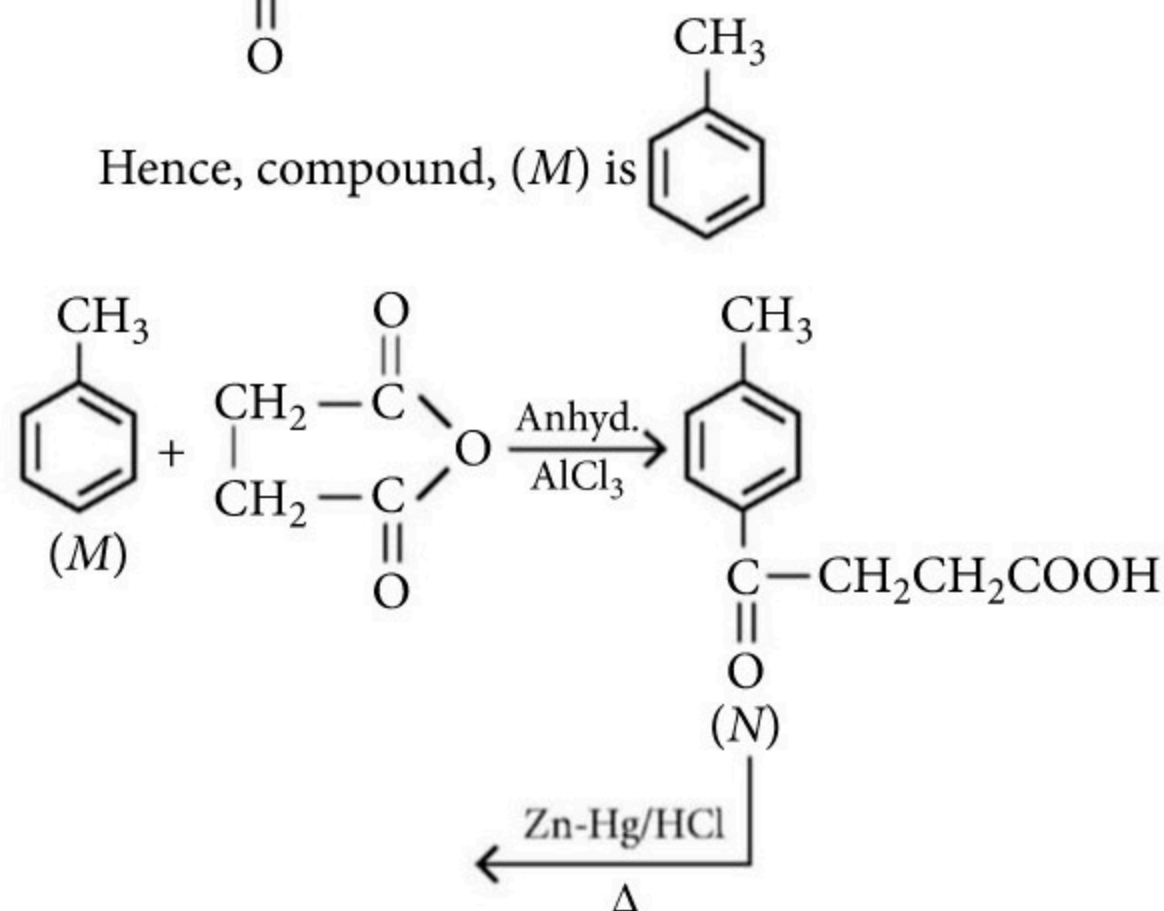


Here Ni^{2+} is $[\text{Ar}]3d^8$, undergoes $d-d$ transition, therefore, coloured.

(5) $[\text{TiF}_6]^{2-}$: Ti^{4+} is $[\text{Ar}]3d^0$ hence, colourless and it is optically inactive.

7. (b): As one mole of compound (M) on ozonolysis gave 2 moles of $\text{CHO}-\text{CHO}$ and one mole of $\text{CH}_3-\text{C}(=\text{O})-\text{CHO}$.

Hence, compound, (M) is



8. (c)

9. (1.46): We know, for monovalent electrolytes;

Eq. conductance, Λ = Molar conductance, Λ_m

$$\text{Given: } \Lambda_{\text{AgNO}_3}^\infty = 116.5 = \Lambda_{\text{Ag}^+}^\infty + \Lambda_{\text{NO}_3^-}^\infty \quad \dots(1)$$

$$\Lambda_{\text{NaCl}}^\infty = 110.3 = \Lambda_{\text{Na}^+}^\infty + \Lambda_{\text{Cl}^-}^\infty \quad \dots(2)$$

$$\Lambda_{\text{NaNO}_3}^\infty = 105.2 = \Lambda_{\text{Na}^+}^\infty + \Lambda_{\text{NO}_3^-}^\infty \quad \dots(3)$$

$$\therefore \Lambda_{\text{AgCl}}^\infty = \text{Eq. (1)} + (2) - (3) = 116.5 + 110.3 - 105.2 = 121.6$$

For sparingly soluble salt, $\Lambda = \Lambda^\infty$

$$\therefore \Lambda_{\text{AgCl}} = 121.6 \text{ mho cm}^2 \text{ eq}^{-1}$$

Given electrolytic conductance of AgCl in water,

$$\kappa_{\text{AgCl} + \text{water}} = 2.40 \times 10^{-6} \text{ mho cm}^{-1}$$

$$\kappa_{\text{water}} = 1.16 \times 10^{-6} \text{ mho cm}^{-1}$$

$$\therefore \kappa_{\text{AgCl}} = 2.40 \times 10^{-6} - 1.16 \times 10^{-6} = 1.24 \times 10^{-6} \text{ mho cm}^{-1}$$

$$\text{Since, } \Lambda = \kappa \times \frac{1000}{C} \quad \therefore 121.6 = 1.24 \times 10^{-6} \times \frac{1000}{C}$$

$$C = \frac{1.24 \times 10^{-3}}{121.6} \text{ mol litre}^{-1}$$

(Mol. wt. of AgCl = 143.4)

$$\therefore C = \frac{1.24 \times 10^{-3}}{121.6} \times 143.4 \text{ g litre}^{-1}$$

$$\text{Solubility of AgCl} = 1.46 \times 10^{-3} \text{ g litre}^{-1}$$

10. (2): Be_2SiO_4 , ZrSiO_4 and Mg_2SiO_4 are orthosilicates.

$\text{Zn}_4\text{Si}_2\text{O}_7(\text{OH})_2 \cdot \text{H}_2\text{O}$ and $\text{Sc}_2(\text{Si}_2\text{O}_7)$ are pyrosilicates.

MgSiO_3 and $\text{Ca}_2\text{Mg}_5(\text{Si}_4\text{O}_{11})_2$ are chain silicates.

Beryl and wollastonite are cyclic silicates.

Mica is a sheet silicate.

Quartz is a 3-D silicate.

GET SET GO NEET

Exam on
May 3, 2020



with exclusive and brain storming MCQs

Practicing these MCQs help to strengthen your concepts and give you extra edge in your NEET preparation

- If van't Hoff factors of aqueous solutions of X, Y and Z are 1.8, 0.8 and 2.5 then which of the following option is correct? (Assume equal concentrations in all three cases.)
(a) Elevation in boiling point : $X < Y < Z$
(b) Depression in freezing point : $Z < X < Y$
(c) Osmotic pressure : $X = Y = Z$
(d) Vapour pressure : $Y < X < Z$
- The most reactive carbonyl compound towards cyanohydrin formation with KCN/H^+ is
(a) CH_3-CHO (b) $\text{Ph}-\text{CH}=\text{O}$
(c) $\text{CH}_3-\overset{\text{O}}{\parallel}{\text{C}}-\text{C}_2\text{H}_5$ (d) $\text{Ph}-\overset{\text{O}}{\parallel}{\text{C}}-\text{CH}_3$
- An fcc lattice has lattice parameter $a = 400$ pm. Calculate the molar volume of the lattice including all the empty space.
(a) 10.8 mL (b) 7.6 mL
(c) 8.6 mL (d) 9.6 mL
- In which of the following polymers, the strong intermolecular hydrogen bonding is present?
(I) Cellulose (II) Nylon
(III) PVC (IV) Polyisoprene
(a) I, III (b) II, IV (c) III, IV (d) I, II
- In Arrhenius equation for a certain reaction, the value of A and E (activation energy) are $6 \times 10^{13} \text{ s}^{-1}$ and 98.6 kJ mol^{-1} respectively. If the reaction is of first order, at what temperature will its half-life period be 20 minutes?
(a) 315.08 K (b) 279.85 K
(c) 298.51 K (d) 302.26 K
- Select the incorrect statement.
(a) In the Baeyer's process, Al_2O_3 goes into solution as soluble $[\text{Al}(\text{OH})_4]^-$ while other basic oxides as TiO_2 and Fe_2O_3 remain insoluble.
(b) Extraction of zinc from zinc blende is achieved by roasting followed by reduction with carbon.
(c) The methods chiefly used for the extraction of mercury and tin are respectively carbon reduction and electrolytic reduction.
(d) Extractive metallurgy of magnesium involves fused salt electrolysis.
- An aromatic amine (X) was treated with alcoholic potash and another compound (Y) then foul smelling gas $\text{C}_6\text{H}_5\text{NC}$ is formed. The compound

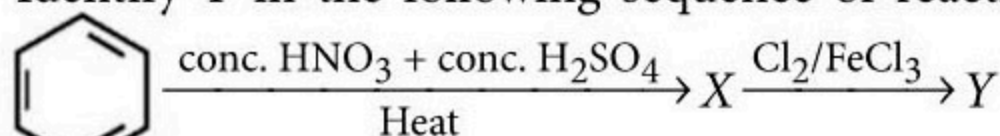
(Y) was formed by reacting compound (Z) with Cl_2 in the presence of slaked lime. The compound (Z) is

- (a) CHCl_3 (b) CH_3COCH_3
(c) CH_3OH (d) $\text{C}_6\text{H}_5\text{NH}_2$

8. XeF_2 reacts with IF_5 to form

- (a) Xe (b) XeF_4
(c) XeF_6 (d) $[\text{XeF}]^+[\text{IF}_6]^-$

9. Identify Y in the following sequence of reaction.



- (a) *p*-chloronitrobenzene
(b) *m*-chloronitrobenzene
(c) *o*-chloronitrobenzene
(d) *o, p*-dichloronitrobenzene

10. Which of the following is present as five membered cyclic structure (furanose structure)?

- (a) Ribose (b) Glucose
(c) Maltose (d) Galactose

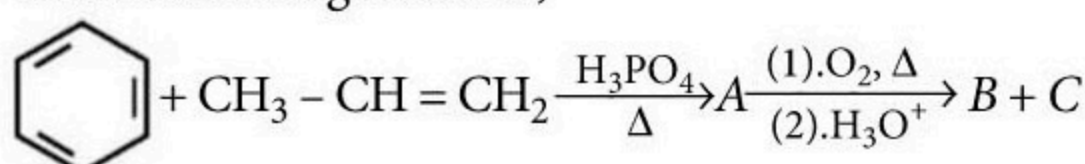
11. Which of the following has minimum gold number?

- (a) Potato starch (b) Gum arabic
(c) Gelatin (d) Albumin

12. Which of the following increasing order of oxidising power is correct for the following species?

- VO_2^+ , MnO_4^- , $\text{Cr}_2\text{O}_7^{2-}$
(a) $\text{VO}_2^+ < \text{Cr}_2\text{O}_7^{2-} < \text{MnO}_4^-$
(b) $\text{VO}_2^+ < \text{MnO}_4^- < \text{Cr}_2\text{O}_7^{2-}$
(c) $\text{Cr}_2\text{O}_7^{2-} < \text{VO}_2^+ < \text{MnO}_4^-$
(d) $\text{Cr}_2\text{O}_7^{2-} < \text{MnO}_4^- < \text{VO}_2^+$

13. In the following reaction,



the products B and C are respectively

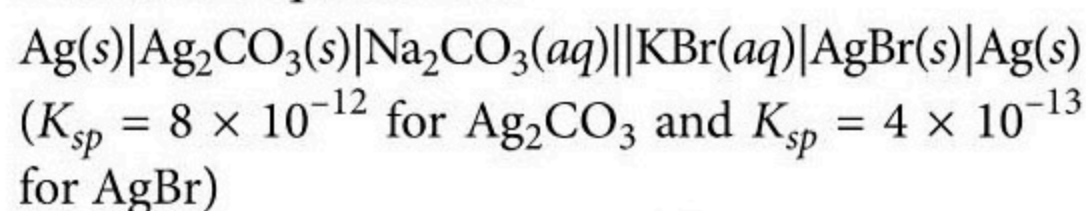
- (a) phenol and acetic acid
(b) phenol and acetaldehyde
(c) benzoic acid and acetone
(d) phenol and acetone.

14. A solution containing 0.319 g of complex $\text{CrCl}_3 \cdot 6\text{H}_2\text{O}$ was passed through cation exchanger and the solution given out was neutralised by 28.5 mL of 0.125 M NaOH. The correct formula of the complex will be

[molecular weight of complex = 266.5]

- (a) $[\text{CrCl}(\text{H}_2\text{O})_5\text{Cl}_2 \cdot \text{H}_2\text{O}]$
(b) $[\text{Cr}(\text{H}_2\text{O})_6]\text{Cl}_3$
(c) $[\text{CrCl}_2(\text{H}_2\text{O})_4]\text{Cl} \cdot 2\text{H}_2\text{O}$
(d) all are correct.

15. At what $\frac{[\text{Br}^-]}{\sqrt{[\text{CO}_3^{2-}]}}$ does the following cell have its reaction at equilibrium?



- (a) $\sqrt{1} \times 10^{-7}$ (b) $\sqrt{2} \times 10^{-7}$
(c) $\sqrt{3} \times 10^{-7}$ (d) $\sqrt{4} \times 10^{-7}$

SOLUTIONS

1. (b): As van't Hoff factor increases :

Relative lowering in vapour pressure increases.

i.e., vapour pressure decreases : $Y > X > Z$

Elevation in boiling point increases *i.e.*, boiling point increases : $Y < X < Z$

Depression in freezing point increases *i.e.*, freezing point decreases : $Y > X > Z$

Osmotic pressure increases : $Y < X < Z$

2. (a): The $-\overset{\text{O}}{\parallel}{\text{C}}-$ group in $\text{CH}_3-\overset{\text{O}}{\parallel}{\text{C}}-\text{H}$ is most electrophilic.

3. (d): In fcc total number of atoms = 4
Volume of 4 atoms = $a^3 = (4 \times 10^{-8})^3 \text{ cm}^3$
Volume of 6.022×10^{23} (N_A) atoms
$$= \frac{(4 \times 10^{-8})^3}{4} \times 6.022 \times 10^{23} = 9.6 \text{ mL}$$

4. (d)

5. (d): Given that, $A = 6 \times 10^{13} \text{ s}^{-1}$, $E_a = 98.6 \text{ kJ mol}^{-1}$
 $t_{1/2} = 20 \times 60 \text{ s}$

For first-order reaction, $k = \frac{0.693}{t_{1/2}} = \frac{0.693}{1200} \text{ s}^{-1}$
 $= 5.77 \times 10^{-4} \text{ s}^{-1}$

Now, $k = Ae^{-E_a/RT}$

$\ln k = \ln A - \frac{E_a}{RT}$

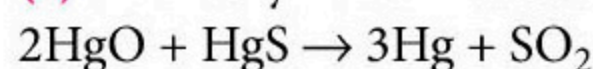
$2.303 \log k = 2.303 \log A - \frac{E_a}{RT}$

or $\log k = \log A - \frac{E_a}{2.303RT} \quad \dots(i)$

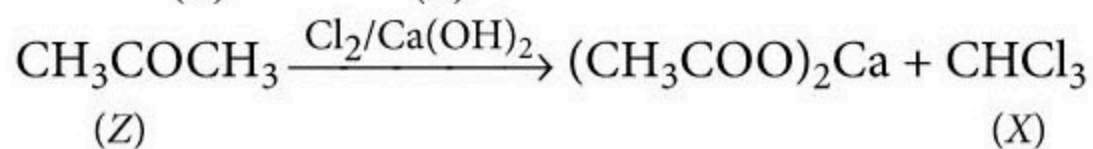
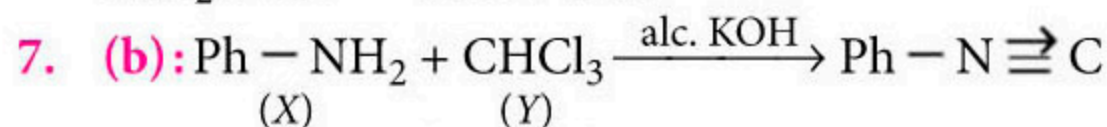
Substituting the value in equation (i)

$\log 5.77 \times 10^{-4} = \log(6 \times 10^{13}) - \frac{98.6}{2.303 \times 8.314 \times 10^{-3} \times T}$
 $T = 302.26 \text{ K}$

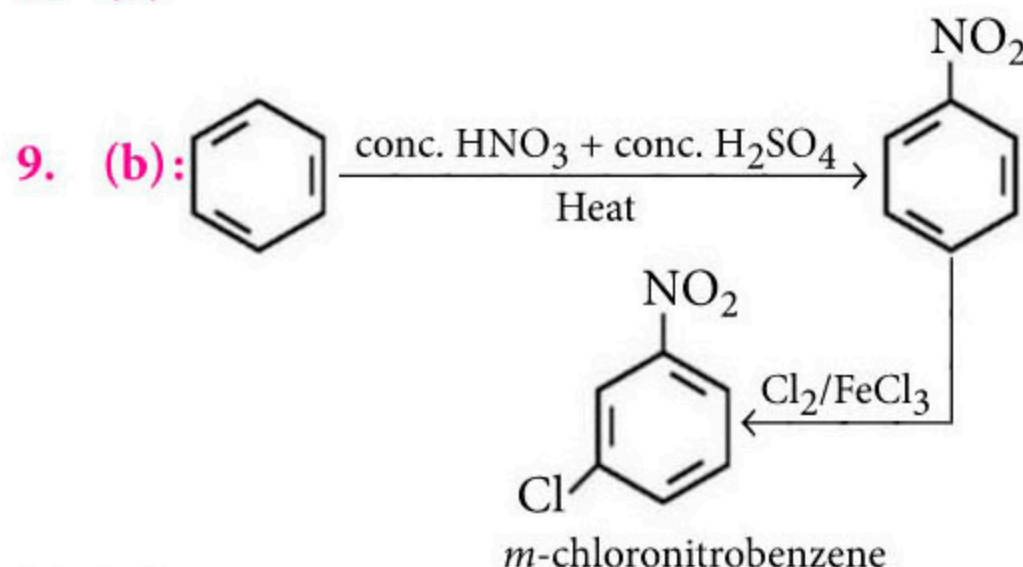
6. (c): Mercury \rightarrow self reduction



Tin \rightarrow carbon reduction,



8. (d)



10. (a)

11. (c): Gelatin has minimum gold number.

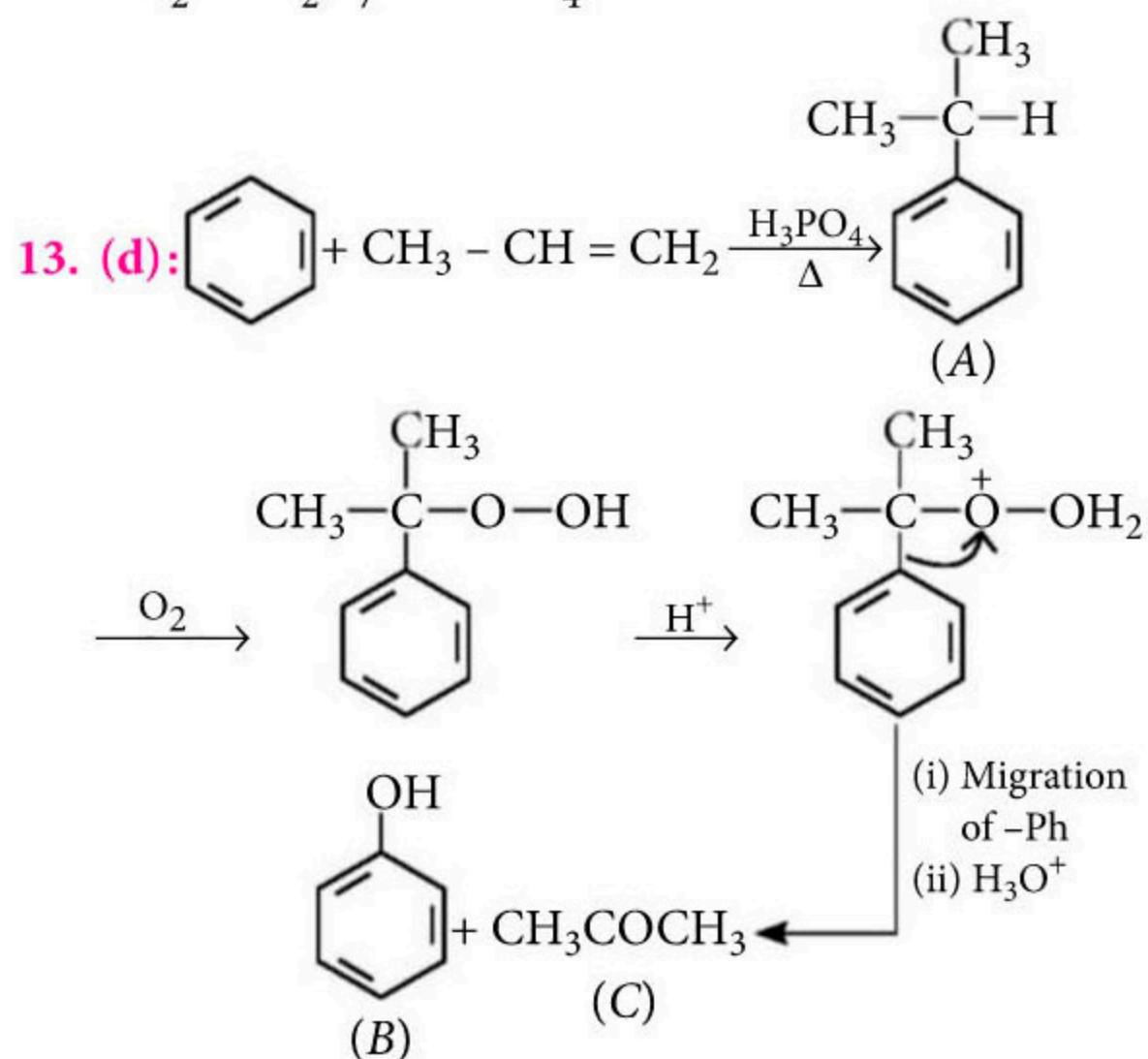
12. (a): This is attributed to the increasing stability of the lower species to which they are reduced.

MnO_4^- is reduced to Mn^{2+} which has stable half filled valence shell electronic configuration $[3d^5]$.

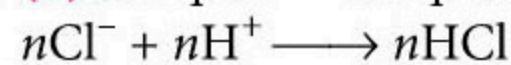
$\text{Cr}_2\text{O}_7^{2-}$ is reduced to Cr^{3+} which has half-filled t_{2g}^3 energy level of $3d$ orbitals in octahedral crystal field splitting.

VO_2^+ is reduced to V^{3+} which has electronic configuration $[\text{Ar}]^{18} 3d^2 4s^0$.

So the order of increasing stability of the reduced species is $\text{Mn}^{2+} > \text{Cr}^{3+} > \text{V}^{3+}$ and, therefore, the increasing order of oxidising power is $\text{VO}_2^+ < \text{Cr}_2\text{O}_7^{2-} < \text{MnO}_4^-$.



14. (b): $\text{meq. Cl}^- = \text{meq. HCl} = \text{meq. NaOH}$



Thus, 1 mol of complex will form n mol of HCl.

1 mole of complex = n mol of HCl = n mole of NaOH

$$\text{Mole of complex} = \frac{0.319}{266.5} = 0.0012$$

$$\text{Mole of NaOH used} = \frac{28.5 \times 0.125}{1000} = 0.0036$$

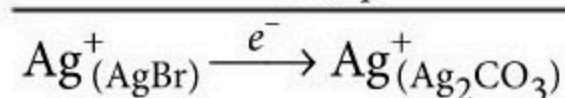
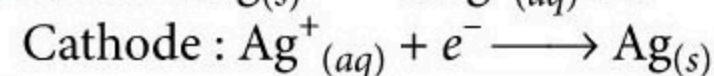
$$\text{So } 0.0012 \text{ mole of complex} = 0.0036 \text{ mole of NaOH} \\ = 0.0036 \text{ mole of HCl}$$

$$1 \text{ mole of complex contain} = \frac{0.0036}{0.0012} = 3 \text{ moles of HCl}$$

$$\therefore n = 3$$

So, complex is $[\text{Cr}(\text{H}_2\text{O})_6]\text{Cl}_3$.

15. (b): Anode: $\text{Ag}_{(s)} \longrightarrow \text{Ag}_{(aq)}^+ + e^-$



$$0 = 0 + \frac{0.0591}{1} \log \frac{\left(\frac{K_{sp}(\text{AgBr})}{[\text{Br}^-]} \right)}{\sqrt{\frac{K_{sp}(\text{Ag}_2\text{CO}_3)}{[\text{CO}_3^{2-}]}}}$$

$$\Rightarrow \frac{K_{sp}(\text{AgBr})}{[\text{Br}^-]} = \sqrt{\frac{K_{sp}(\text{Ag}_2\text{CO}_3)}{[\text{CO}_3^{2-}]}}$$

$$\Rightarrow \frac{4 \times 10^{-13}}{\sqrt{8 \times 10^{-12}}} = \frac{[\text{Br}^-]}{\sqrt{[\text{CO}_3^{2-}]}}$$

$$\Rightarrow \frac{[\text{Br}^-]}{\sqrt{[\text{CO}_3^{2-}]}} = \sqrt{2} \times 10^{-7}$$



COMIC CAPSULE

What is the
Chemical Formula
for Coffee?

$\text{CO}(\text{FE})_2$



CLASS-XII

for **NEET/JEE**

2020

BRUSH UP

Brush up your concepts to get high rank in NEET/JEE (Main and Advanced) by reading this column. This specially designed column is updated year after year by a panel of highly qualified teaching experts well-tuned to the requirements of these Entrance Tests.

**Unit
7**

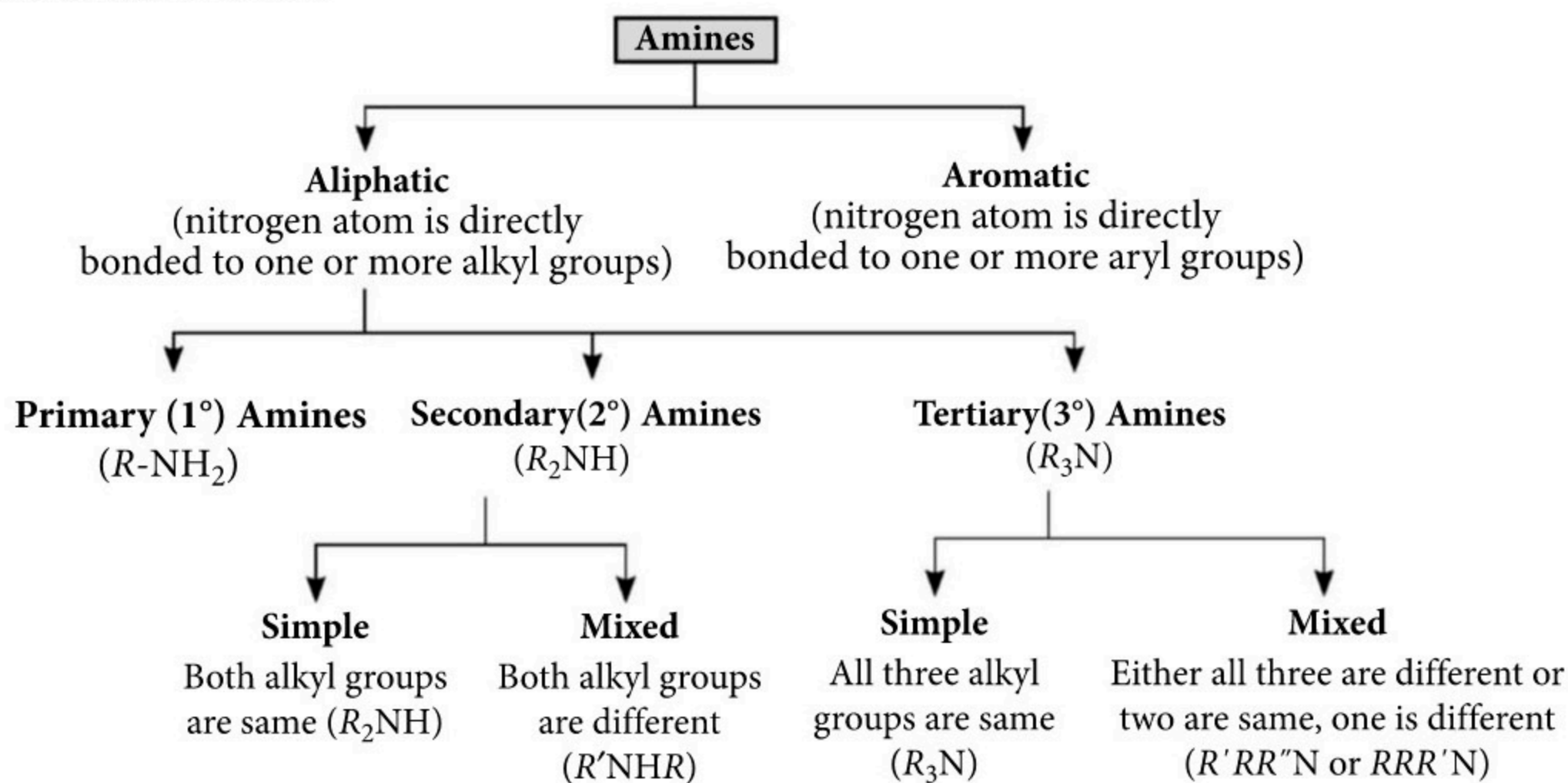
Organic Compounds Containing Nitrogen | Biomolecules

Organic Compounds Containing Nitrogen

AMINES

- Amines are derivatives of ammonia, in which one or more hydrogen atoms are replaced by alkyl or aryl groups.

Classification of amines



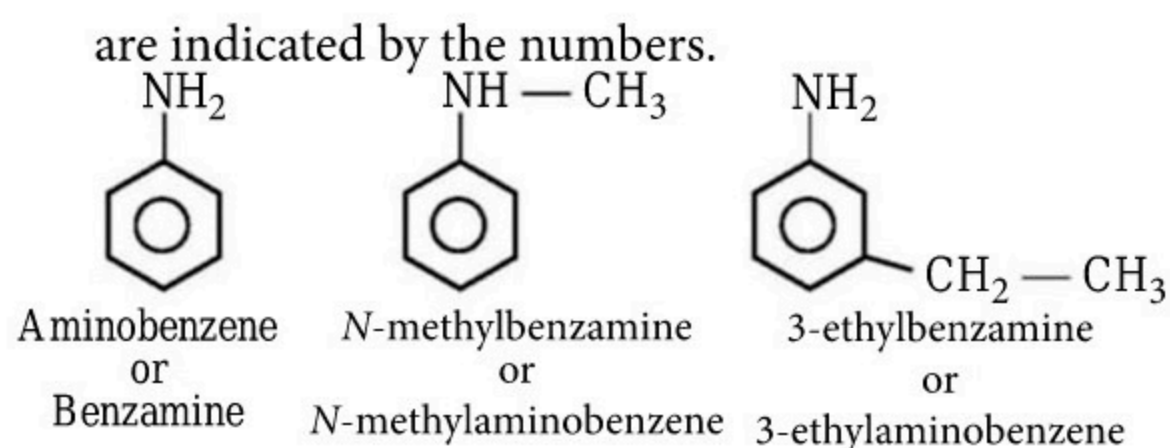
Nomenclature

- Aliphatic amines are called alkanamines in which 'e' of alkane is replaced by amine. For example,
 $\text{CH}_3 - \text{CH}_2\text{NH}_2$ $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{NH}_2$
 Ethanamine Propan-1-amine or 1-propanamine
- The secondary and tertiary amines are named

as nitrogen substituted primary amine *i.e.*, *N*-alkylaminoalkanes (for 2° amine) and *N,N*-dialkylaminoalkanes (for 3° amine). The largest alkyl part is considered as a part of aminoalkane. *N*- and *N,N*- means that alkyl groups are linked to *N*-atom, not to carbon atom.

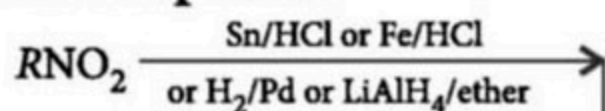
For example,
 $\text{CH}_3 - \text{CH}_2 - \text{N}(\text{CH}_2\text{CH}_3)_2 - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \text{CH}_3$
 N, N-Diethylbutan-1-amine

- The simplest aromatic amine is aniline. Other aromatic amines are named as derivatives of benzamine and the positions of the other groups

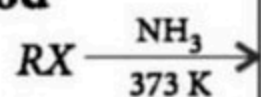


Preparation

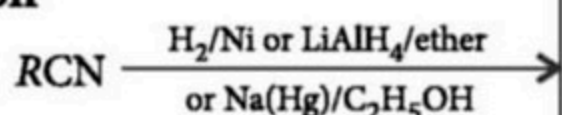
Reduction of nitro compounds



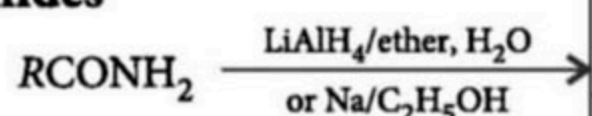
Hofmann's ammonolysis method



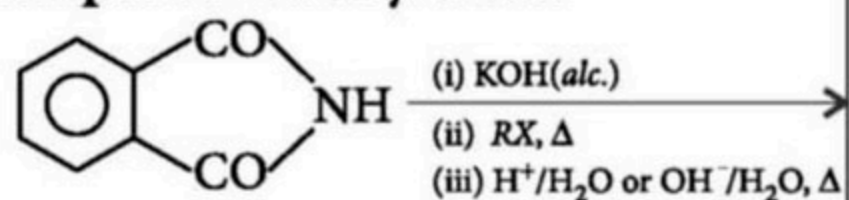
Mendius reduction



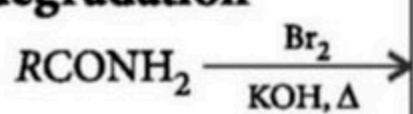
Reduction of amides



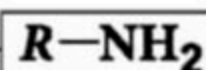
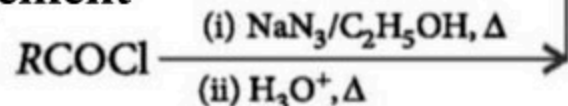
Gabriel phthalimide synthesis



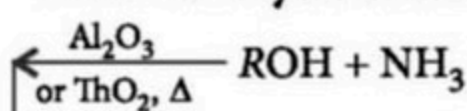
Hofmann's bromamide degradation



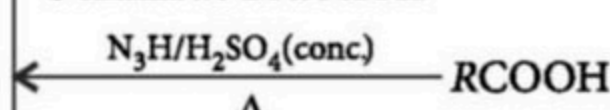
Curtius rearrangement



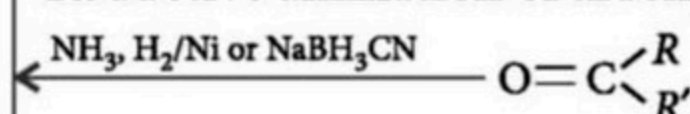
Ammonolysis of alcohols



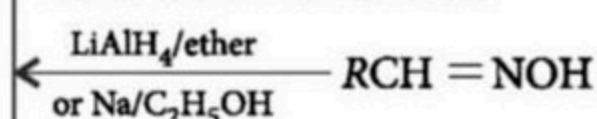
Schmidt reaction



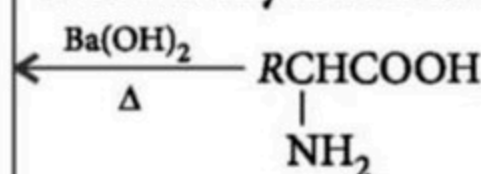
Reductive amination of aldehydes or ketones



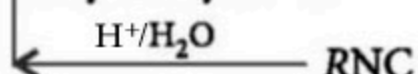
Reduction of oximes



Decarboxylation of α-amino acids



Hydrolysis of isocyanides



Chemical Properties of amine

- Basic character :** The amines are basic in nature due to the presence of a lone pair of electron on N-atom of the $-\text{NH}_2$ group, which it can donate to electron deficient compounds. Aliphatic amines are stronger bases than NH_3 because of the +I effect of the alkyl groups. Greater the number of alkyl groups attached to N-atom, higher is the electron density on it and more will be the basicity. Thus, the order of basic nature of amines is expected to be $3^\circ > 2^\circ > 1^\circ$, however the observed order is $2^\circ > 1^\circ > 3^\circ$. This is explained on the basis of crowding of N-atom of the amine by alkyl groups which hinders the approach and bonding by a proton, consequently, the electron pair which is present on N is unavailable for donation and hence 3° amines are the weakest bases. The order of basicity varies with the nature of alkyl group.

Alkyl group

Basic strength

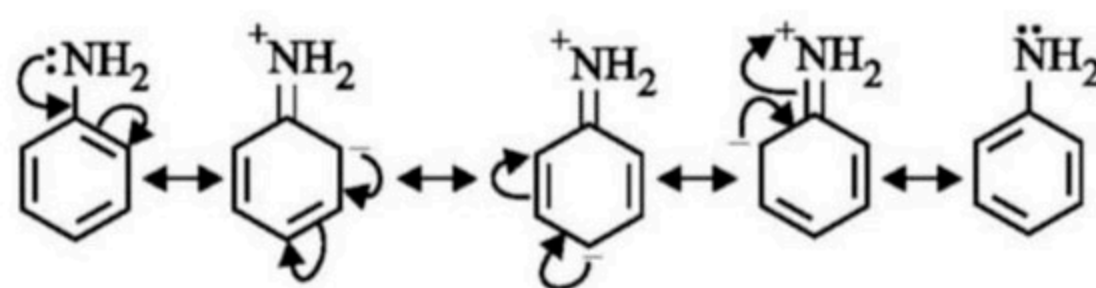
$\text{CH}_3 -$

$\text{R}_2\text{NH} > \text{RNH}_2 > \text{R}_3\text{N} > \text{NH}_3$

$\text{C}_2\text{H}_5 -$

$\text{R}_2\text{NH} > \text{R}_3\text{N} > \text{RNH}_2 > \text{NH}_3$

Aniline is a weaker base as compared to ammonia. This is because the lone pair of electrons on N-atom of aniline is less available for protonation due to its involvement in conjugation with the π -electrons of the benzene ring.

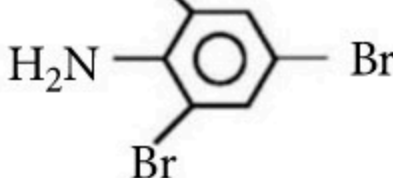





Further the presence of electron withdrawing groups like $-\text{NO}_2$, $-\text{CN}$, $-\text{X}$, etc., decreases the basicity while, the presence of electron donating groups like $-\text{OCH}_3$, $-\text{CH}_3$, $-\text{NH}_2$, etc., activates the benzene ring and also increases the basicity.

34



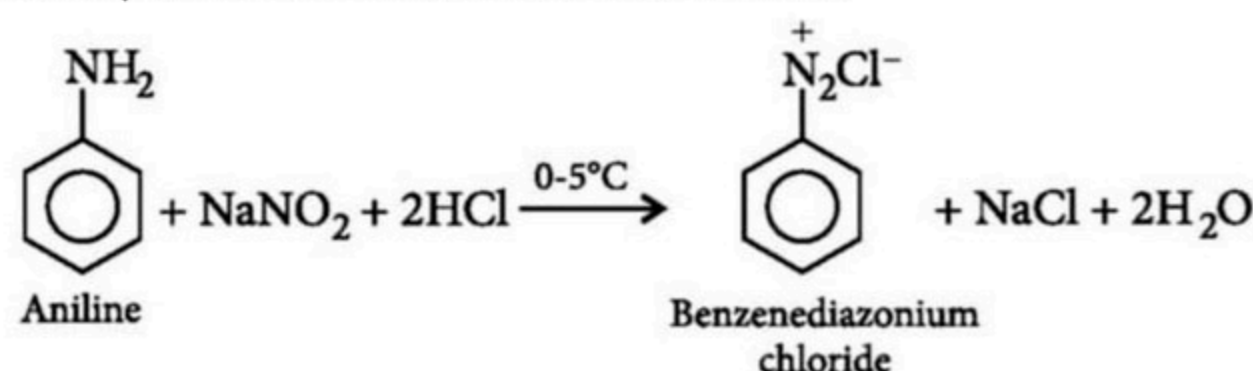
Chemical Properties of Aniline

- $\text{C}_6\text{H}_5\text{NH}_2$
- $\xrightarrow[\text{NaOH}]{\text{C}_6\text{H}_5\text{COCl}}$
 $\text{C}_6\text{H}_5\text{NHCO}\text{C}_6\text{H}_5$
 (Schotten-Baumann reaction)
 - $\xrightarrow[0 - 5^\circ\text{C}]{\text{NaNO}_2, \text{HCl}}$
 $\text{C}_6\text{H}_5\text{N}_2^+\text{Cl}^-$
 (Benzene diazonium chloride)
 - $\xrightarrow[\text{KOH}]{\text{CS}_2}$
 $(\text{C}_6\text{H}_5\text{NH})_2\text{CS}$
 Diphenyl thiourea
 - $\xrightarrow{\text{Br}_2}$

 2,4,6-Tribromoaniline
 - $\xrightarrow{\text{conc. H}_2\text{SO}_4}$

p-amino benzene sulphonic acid
 - $\xrightarrow[\text{conc. H}_2\text{SO}_4]{\text{conc. HNO}_3}$

p-nitro aniline
 - $\xrightarrow[\text{[O]}]{\text{K}_2\text{Cr}_2\text{O}_7/\text{H}^+}$

p-Benzoquinone

- Arenediazonium salts** : They have the general formula ArN_2^+X^- , Ar stands for the aryl ($-\text{C}_6\text{H}_5$) group and X^- is Cl^- , Br^- , NO_3^- , HSO_4^- , BF_4^- .

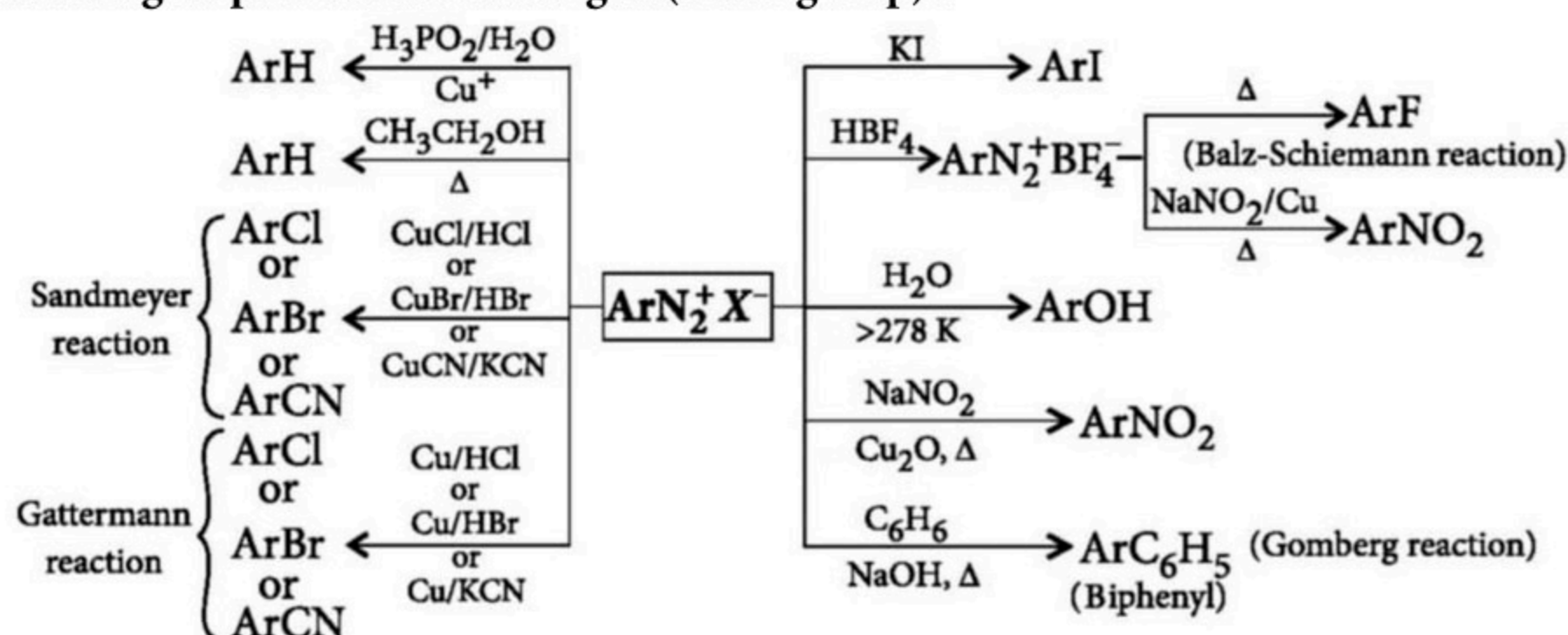
Preparation

- Aromatic diazonium salts are prepared by adding cold aqueous solution of sodium nitrite to the ice cold solution (0-5°C) of a primary aromatic amine in excess of acid.

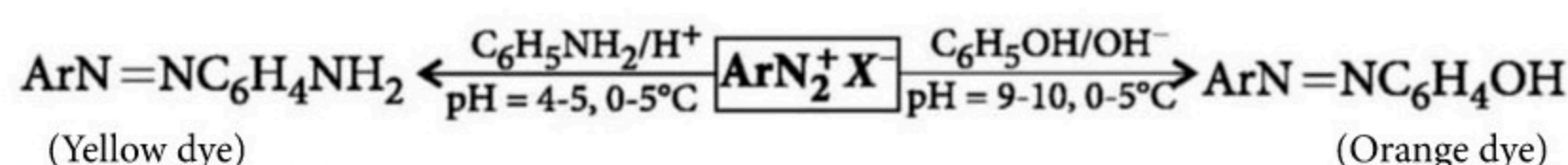


Chemical Properties

- Reactions involving displacement of nitrogen (diazo group) :



- Reactions involving retention of diazo group (coupling reactions) :



PEEP INTO PREVIOUS YEARS

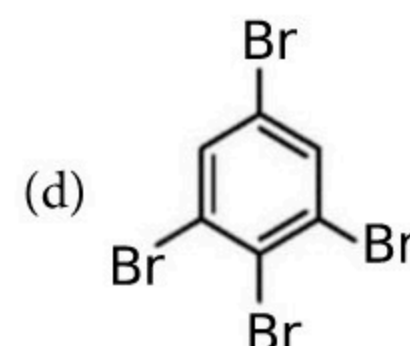
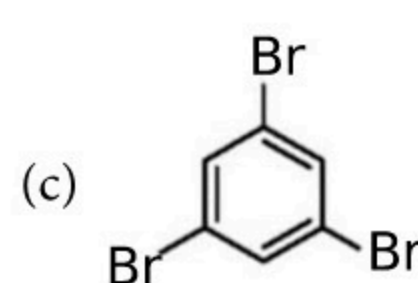
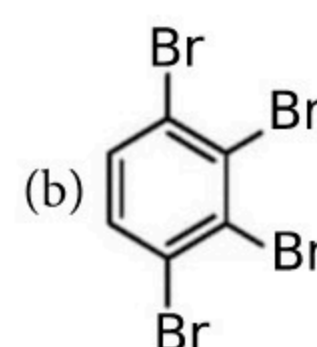
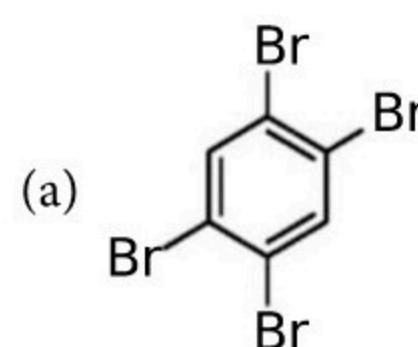
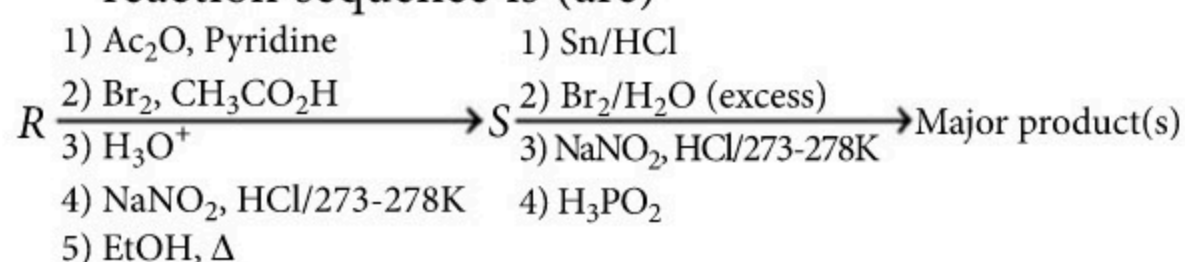
- The correct order of the basic strength of methyl substituted amines in aqueous solution is
 (a) $\text{CH}_3\text{NH}_2 > (\text{CH}_3)_2\text{NH} > (\text{CH}_3)_3\text{N}$
 (b) $(\text{CH}_3)_2\text{NH} > \text{CH}_3\text{NH}_2 > (\text{CH}_3)_3\text{N}$
 (c) $(\text{CH}_3)_3\text{N} > \text{CH}_3\text{NH}_2 > (\text{CH}_3)_2\text{NH}$
 (d) $(\text{CH}_3)_3\text{N} > (\text{CH}_3)_2\text{NH} > \text{CH}_3\text{NH}_2$

(NEET 2019)

- Ethylamine ($\text{C}_2\text{H}_5\text{NH}_2$) can be obtained from N-ethylphthalimide on treatment with
 (a) H_2O (b) NH_2NH_2
 (c) NaBH_4 (d) CaH_2

(JEE Main 2019)

- Aniline reacts with mixed acid (conc. HNO_3 and conc. H_2SO_4) at 288 K to give P (51 %), Q (47%) and R (2%). The major product(s) of the following reaction sequence is (are)



(JEE Advanced 2018)

Monthly Test Drive CLASS XI

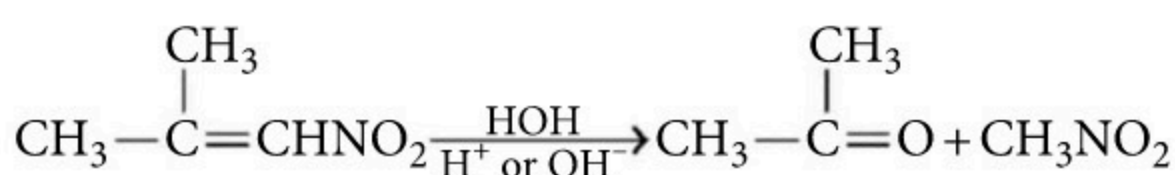
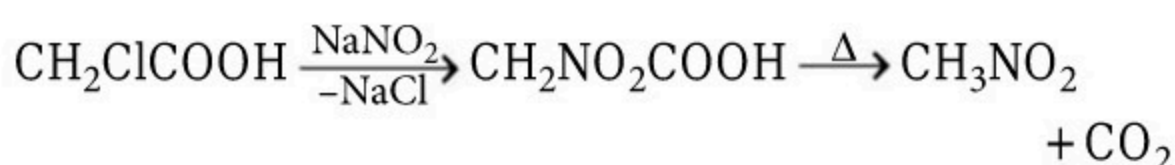
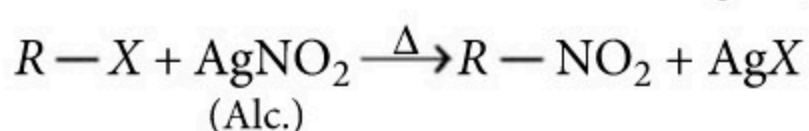
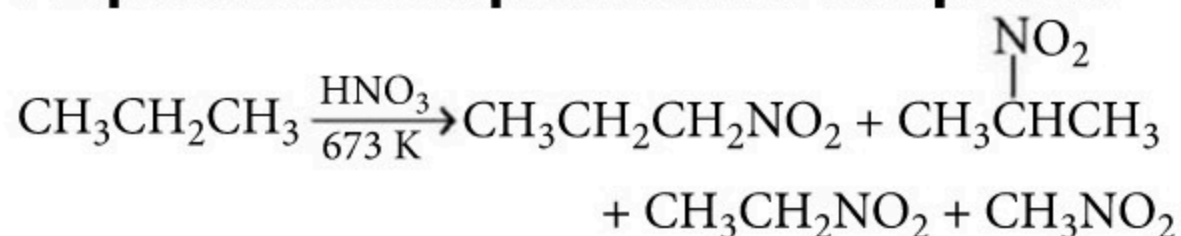
ANSWER KEY

- | | | | | |
|-----------|-------------|-------------|---------|-------------|
| 1. (c) | 2. (d) | 3. (c) | 4. (d) | 5. (a) |
| 6. (a) | 7. (d) | 8. (c) | 9. (a) | 10. (a) |
| 11. (c) | 12. (b) | 13. (c) | 14. (b) | 15. (a) |
| 16. (d) | 17. (a) | 18. (c) | 19. (a) | 20. (a,b,d) |
| 21. (a,b) | 22. (a,b,c) | 23. (a,c,d) | 24. (3) | 25. (6) |
| 26. (2,5) | 27. (a) | 28. (d) | 29. (c) | 30. (d) |

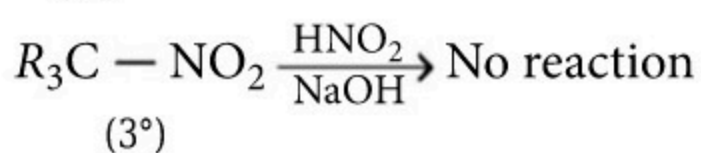
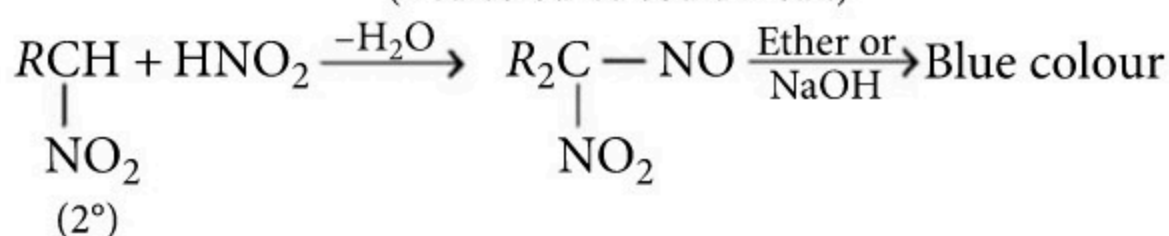
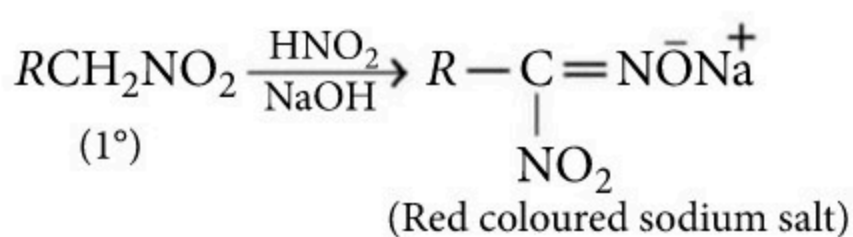
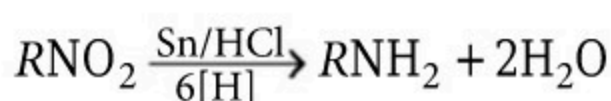
NITRO COMPOUNDS

- Nitro compounds have the general formula RNO_2 or $ArNO_2$, where R is alkyl and Ar is aryl groups e.g., CH_3NO_2 , $C_6H_5NO_2$

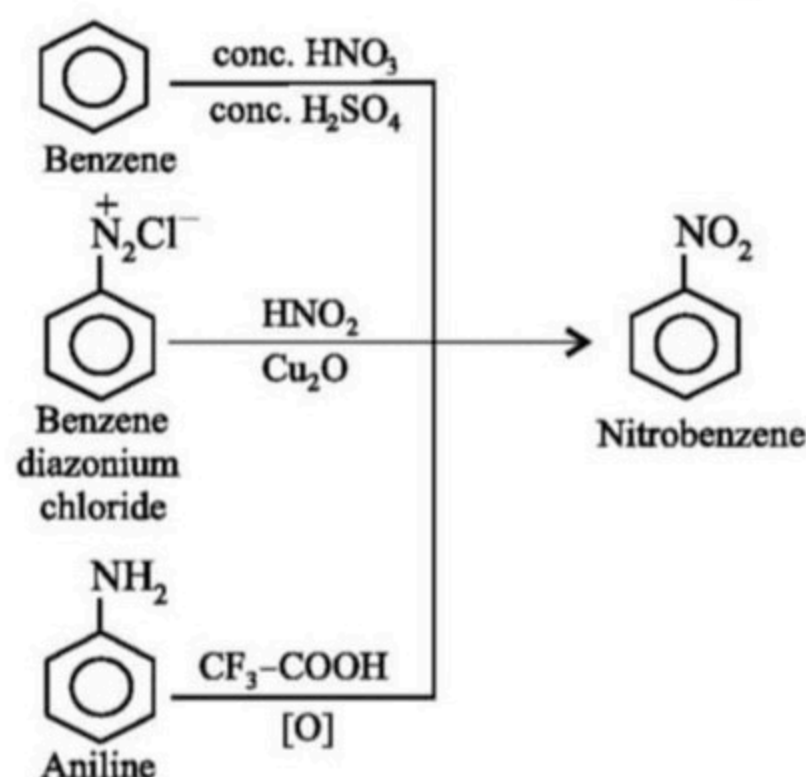
Preparation of Aliphatic Nitro compound



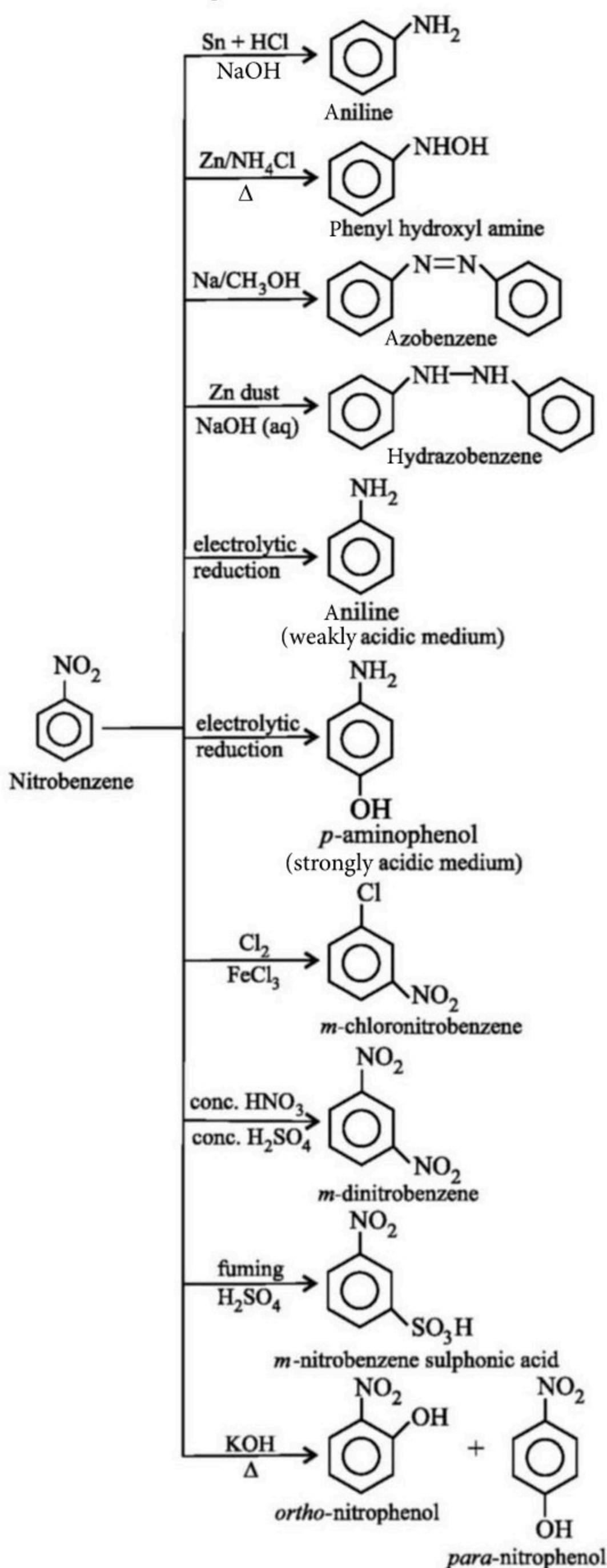
Chemical Properties



Preparation of aromatic nitro compound



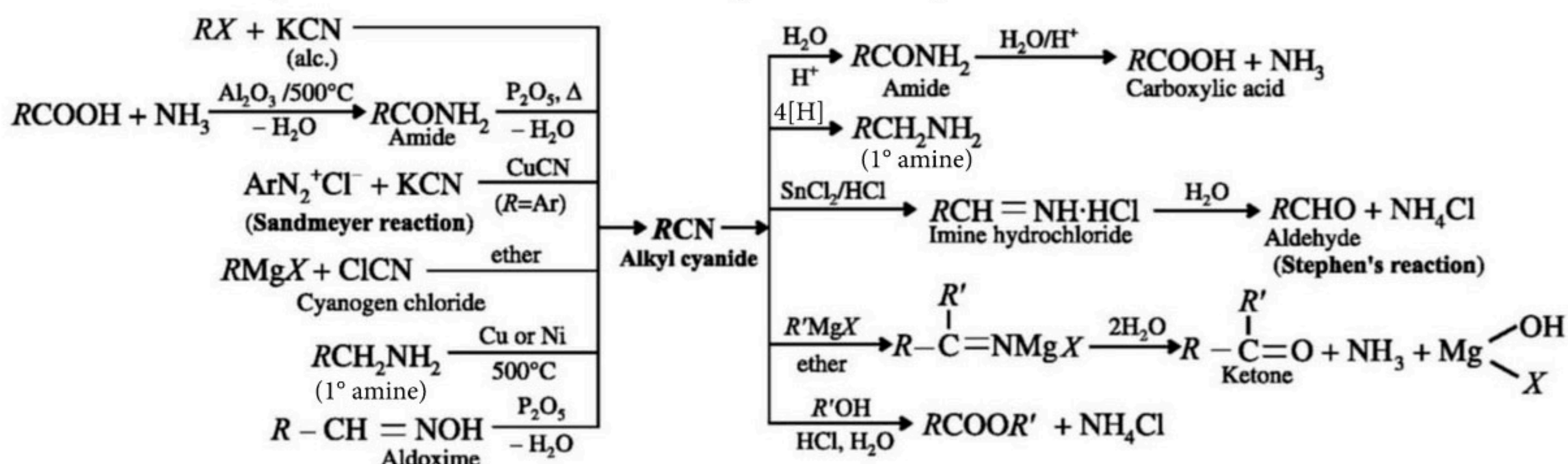
Chemical Properties



CYANIDES

- These are represented as $R-C\equiv N$.
- Alkyl cyanides are also known as *nitriles* or carbonitriles.

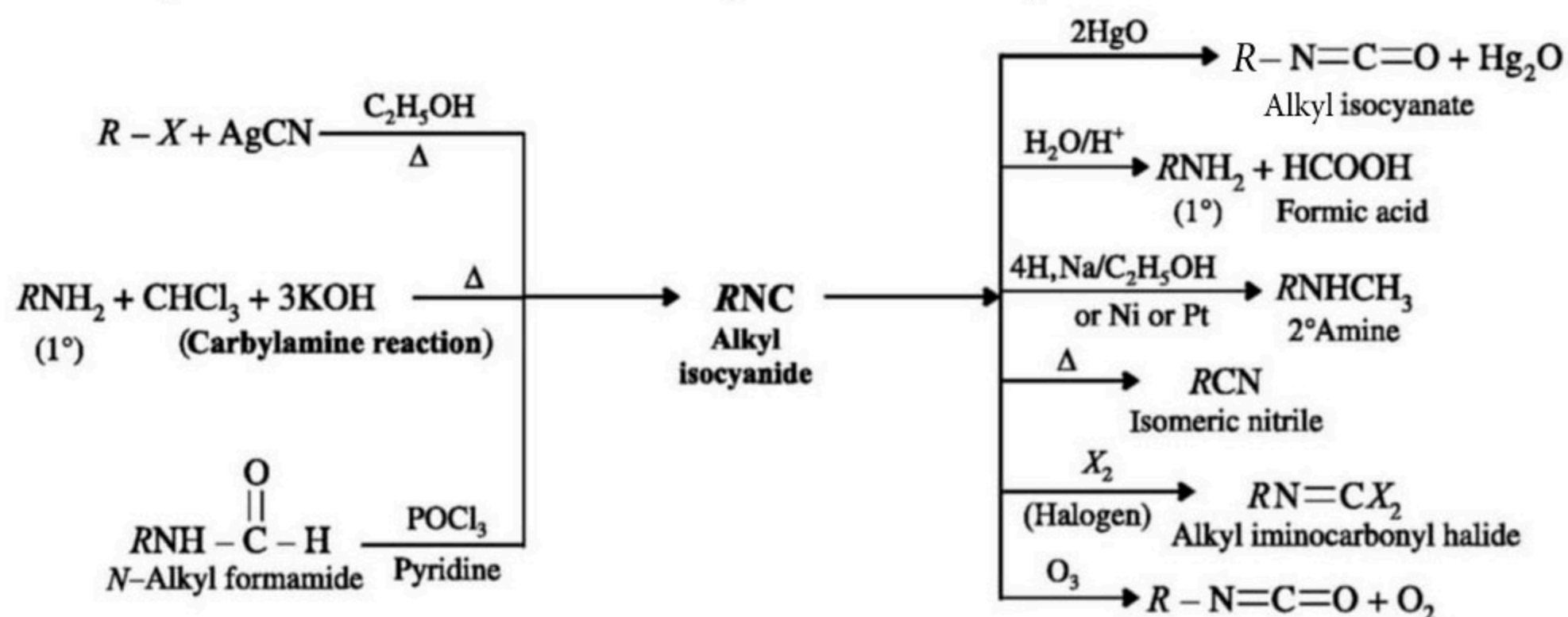
Methods of Preparation and Chemical Properties of Cyanides



ISOCYANIDES

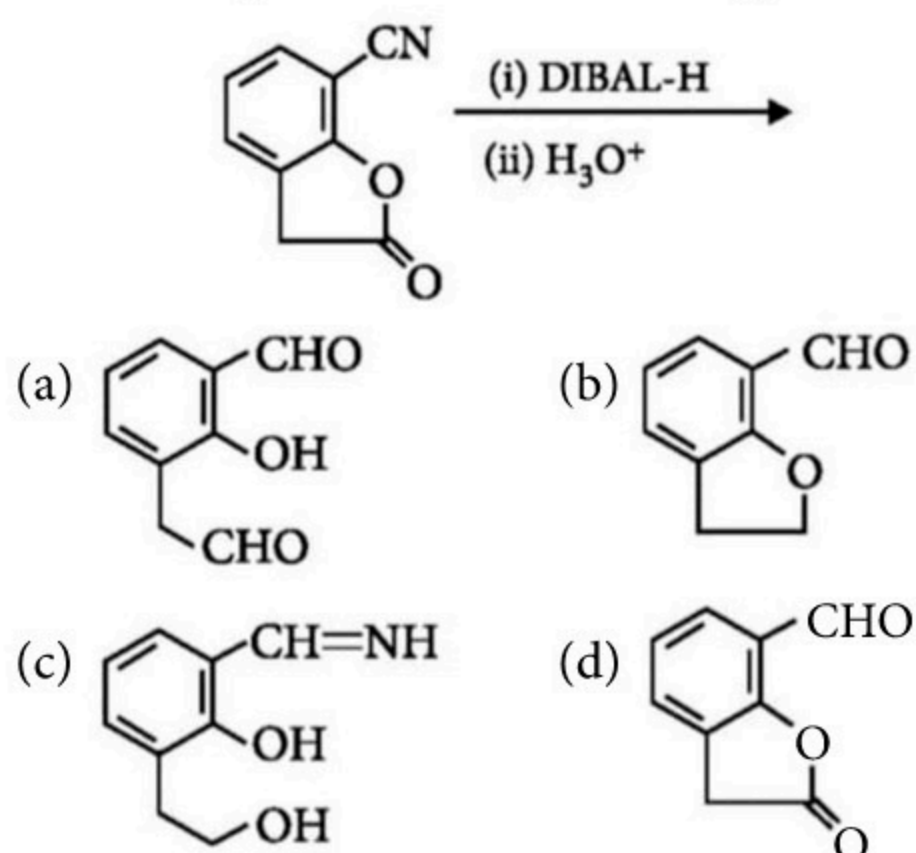
- These are represented as $RN \equiv C$
- Alkyl isocyanides are also known as isonitriles or carbylamines.

Methods of Preparation and Chemical Properties of Isocyanides



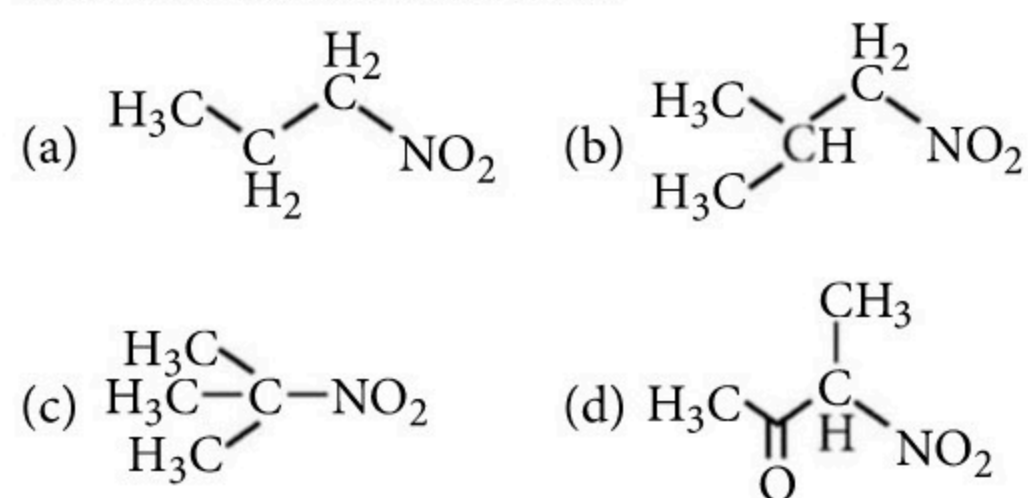
PEEP INTO PREVIOUS YEARS

4. The main product of the following reaction is



(JEE Main 2019)

5. Which one of the following nitro-compounds does not react with nitrous acid?



(NEET-II 2016)

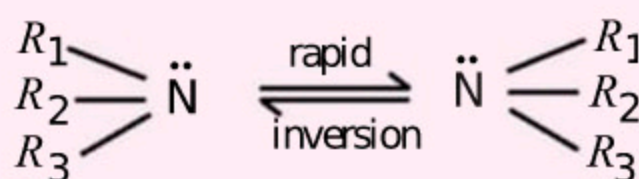
Quotable Quote

"If you want to live a happy life, tie it to a goal. Not to people or things."

ALBERT EINSTEIN

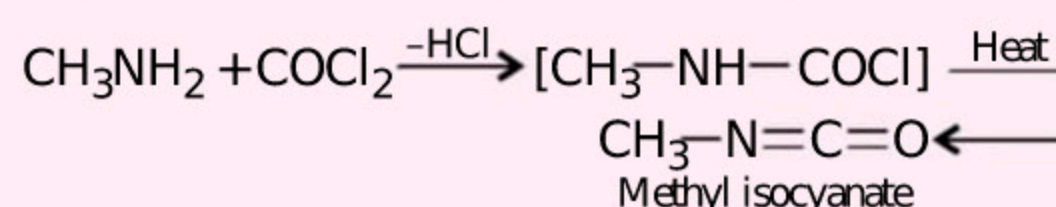
POINTS FOR EXTRA SCORING

- The mixed tertiary amines undergo a phenomenon known as *flipping* or *amine inversion*, whereby the amines exist as a racemic mixture which cannot be resolved into the enantiomeric forms by virtue of this phenomenon.



- Elimination in alkyl-trimethyl ammonium hydroxide proceeds in the direction that gives less substituted alkene. It is less sterically hindered β -hydrogen that is removed by the base in Hoffmann reaction.

- Aliphatic amines are stronger bases than ammonia due to the +I effect of alkyl groups present in amines.
- Aromatic amines are weaker bases than ammonia due to -I effect of aryl group.
- In gaseous phase, the order of basicity of amines is 3° amine > 2° amine > 1° amine > NH_3 .
- The famous Bhopal gas tragedy in Dec., 1984 was caused by extremely poisonous methyl isocyanate (MIC). Methyl isocyanate is industrially prepared by the action of methylamine with phosgene.



Biomolecules

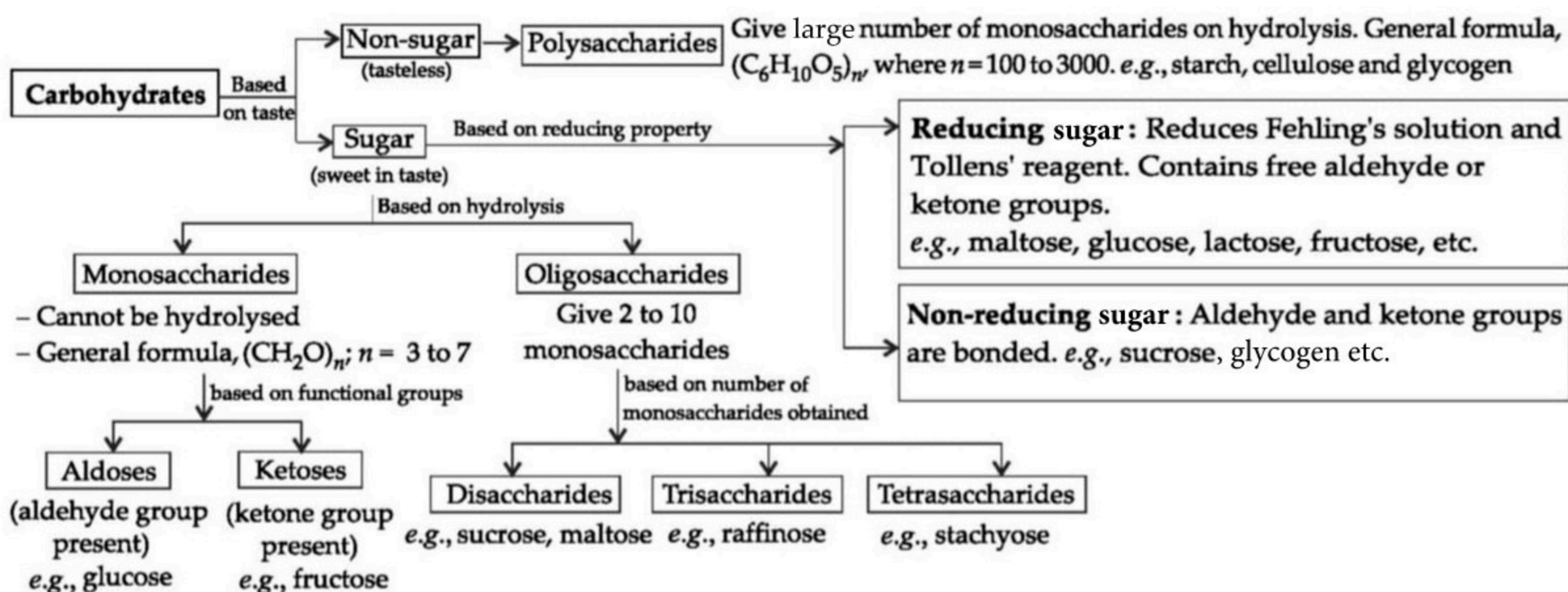
The complex chemical substances which form the basis of life, *i.e.*, they not only build up living systems (creatures) but are also responsible for their growth, maintenance and their ability to reproduce are called biomolecules.

Examples : Carbohydrates, Hormones, Proteins, Vitamins, Enzymes, Nucleic acids, etc.

CARBOHYDRATES

Carbohydrates are defined as optically active polyhydroxy aldehydes or ketones or substances which give these on hydrolysis and contain at least one chiral carbon. Their general formula is $\text{C}_x(\text{H}_2\text{O})_y$ where x and y can be 3, 4, 5 etc. They occur naturally in animal and plant kingdom and are composed of carbon, hydrogen and oxygen only.

Classification of Carbohydrates

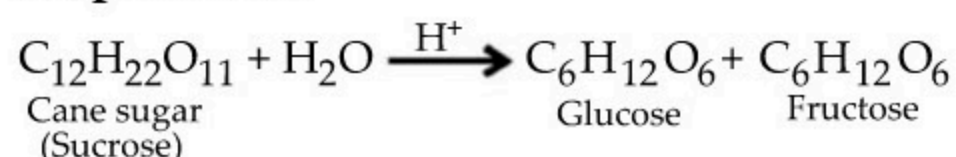


MONOSACCHARIDES

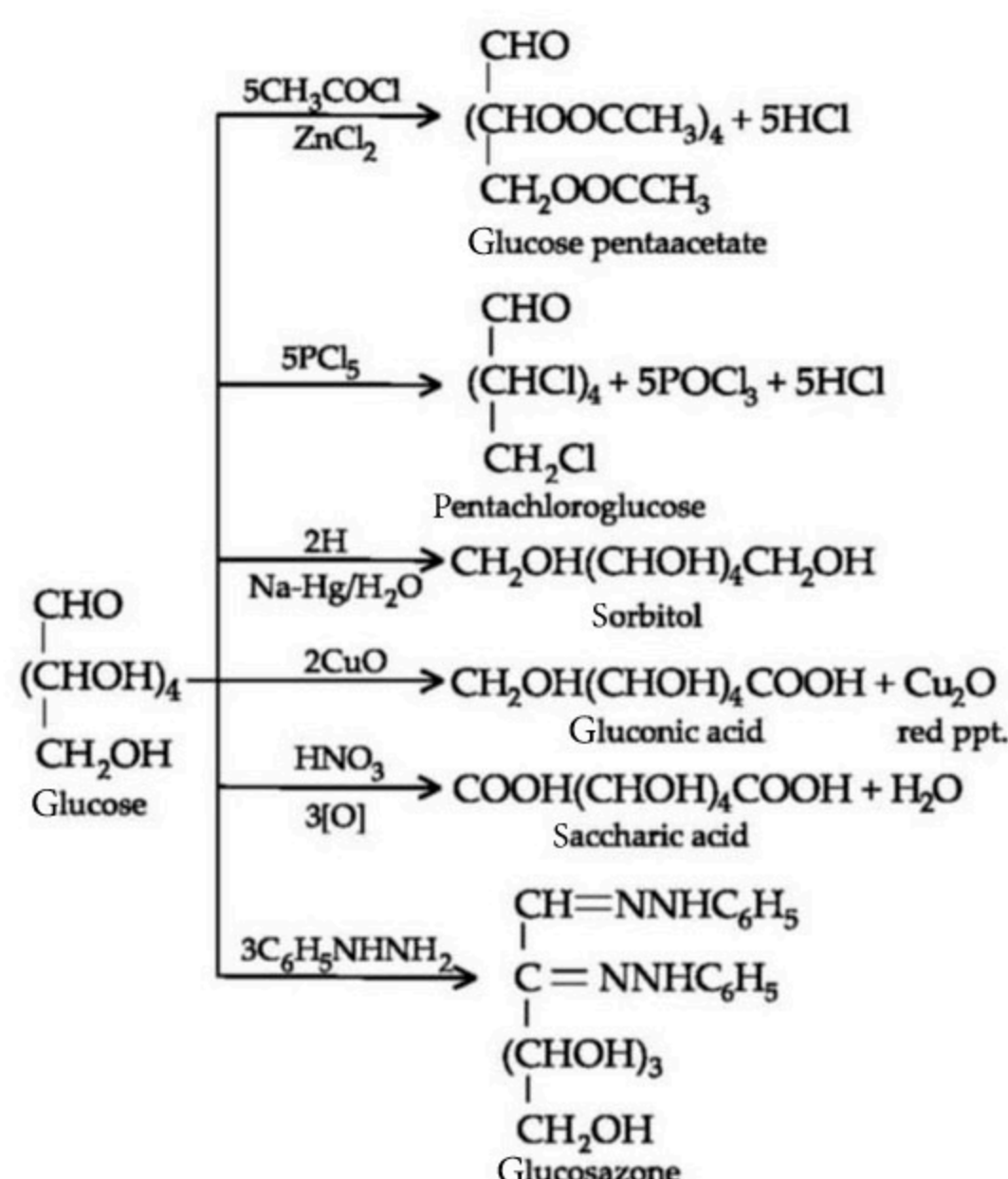
Glucose (C₆H₁₂O₆)

- Glucose is known as *dextrose* because it occurs in nature as an optically active dextrorotatory isomer.

– **Preparation :**

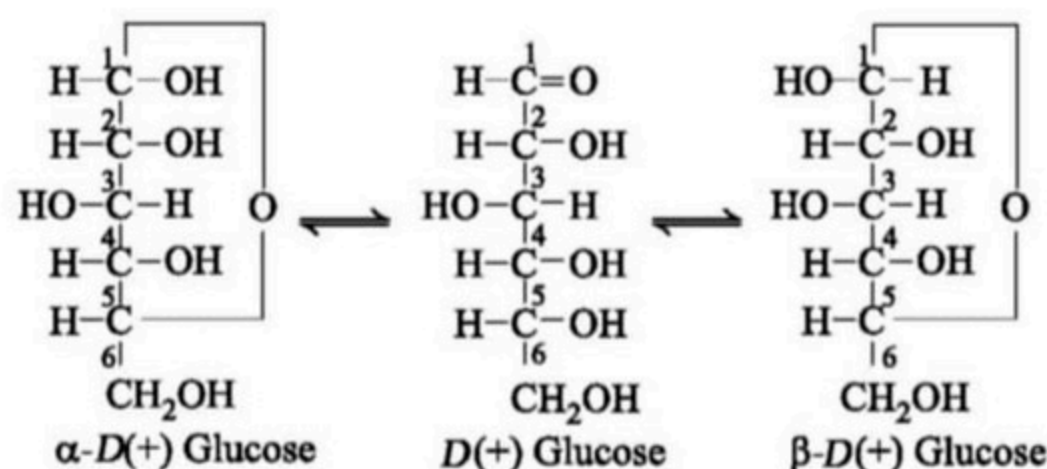


– **Chemical reactions :**



Structure of glucose

- The straight chain form of glucose explained most of its properties but could not explain a few reactions and observations like
 - No reaction with 2,4-DNP and NaHSO₃.
 - No reaction of its pentaacetate with NH₂OH.
 - Existence of α and β-forms of glucose.
- These could however be explained by the cyclic structure of glucose which exists in equilibrium with the open chain form.



Anomers

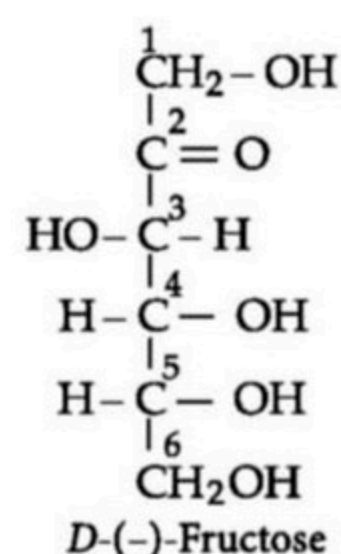
- Due to ring formation, hemiacetal or hemiketal carbon C₁ becomes chiral and hence, the monosaccharide exists in two stereoisomeric forms, the α and the β-forms. If the –OH group attached to hemiacetal or hemiketal carbon is towards right it is called an α-form and if the –OH group is towards left it is called β-form. Such a pair of stereoisomers which differ in configuration only around hemiacetal or hemiketal carbon (C₁) are called anomers and the carbon is called anomeric carbon or glycosidic carbon.

Mutarotation

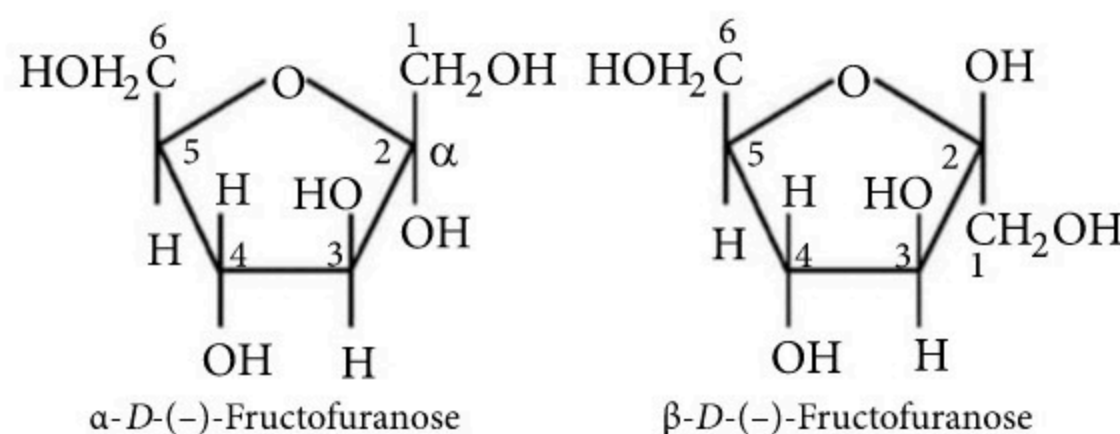
- A freshly prepared aqueous solution of α-D-(+)-glucose has a specific rotation of +111°. When this solution is allowed to stand, specific rotation falls to +52.5° and remains constant at this value. On the other hand, specific rotation of β-D-(+)-glucose increases from +19.2° to 52.5° with time. This change in specific rotation of an optically active compound in solution with time, to an equilibrium value is known as mutarotation. All the reducing sugars undergo mutarotation.

Fructose (C₆H₁₂O₆)

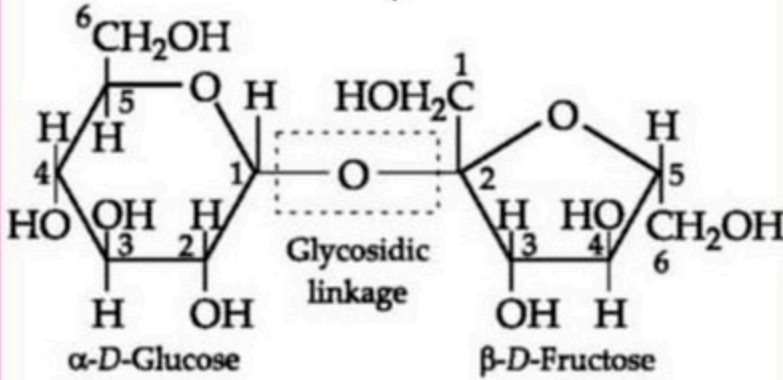
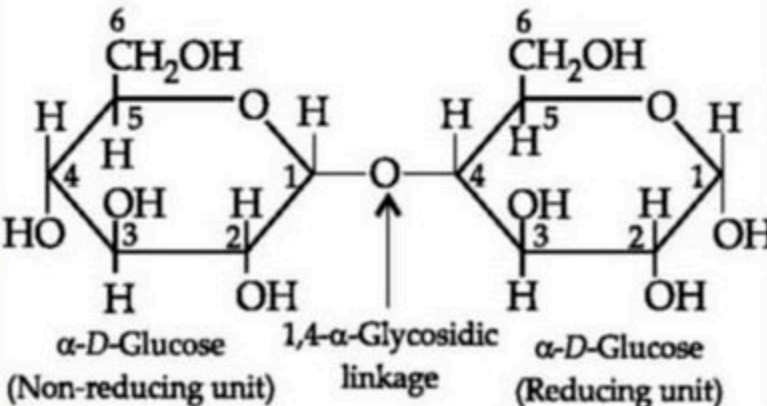
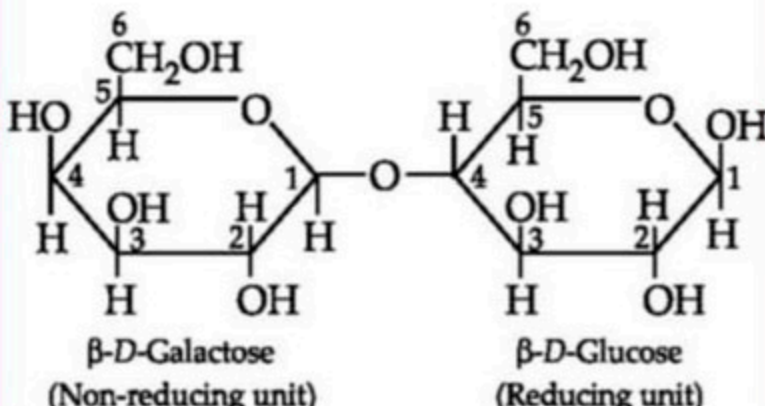
- It is present in abundance in sweet fruits. Since naturally occurring fructose is laevorotatory, it is known as laevulose.



- The cyclic structures of two anomers of fructose are represented by Haworth structures as given :



DISACCHARIDES

Sucrose ($C_{12}H_{22}O_{11}$)	Maltose ($C_{12}H_{22}O_{11}$)	Lactose ($C_{12}H_{22}O_{11}$)
<ul style="list-style-type: none"> – Cane sugar – Non-reducing sugar – Dextrorotatory 	<ul style="list-style-type: none"> – Malt sugar – Reducing sugar – Dextrorotatory 	<ul style="list-style-type: none"> – Milk sugar – Reducing sugar – Epimeric in nature
 <p>α-D-Glucose</p> <p>β-D-Fructose</p> <p>Glycosidic linkage</p>	 <p>α-D-Glucose (Non-reducing unit)</p> <p>1,4-α-Glycosidic linkage</p> <p>α-D-Glucose (Reducing unit)</p>	 <p>β-D-Galactose (Non-reducing unit)</p> <p>β-D-Glucose (Reducing unit)</p>

POLYSACCHARIDES

- **Starch** ($C_6H_{10}O_5$)_n is the main storage polysaccharide of plants. It is a polymer of α -D-glucose units and consists of two components : amylose and amylopectin.

Amylose is water soluble component which constitutes about 15-20% of starch. Chemically, amylose is a long unbranched chain with 200-1000 α -D-(+)-glucose units held by 1,4- α -glycosidic linkage.

Amylopectin is insoluble in water and constitutes about 80-85% of starch. It is a branched chain polymer of α -D-glucose units in which chain is formed by 1,4- α -glycosidic linkage whereas branching occurs by 1,6- α -glycosidic linkage.

- **Cellulose**, ($C_6H_{10}O_5$)_n is a straight chain polysaccharide composed only of β -D-glucose units which are joined together by 1,4- β -glycosidic linkages *i.e.*, the β -glycosidic linkages between C-1 of one glucose and C-4 of the next glucose unit.
- **Glycogen (animal starch)** ($C_6H_{10}O_5$)_n is a major constituent of liver, muscles and brain and when the body needs glucose, enzymes break the glycogen down to glucose.



PEEP INTO PREVIOUS YEARS

- Which of the following statement(s) is(are) true?
 - The two six-membered cyclic hemiacetal forms of D-(+)-glucose are called anomers.
 - Hydrolysis of sucrose gives dextrorotatory glucose and laevorotatory fructose.

(c) Monosaccharides cannot be hydrolysed to give polyhydroxy aldehydes and ketones.

(d) Oxidation of glucose with bromine water gives glutamic acid. **(JEE Advanced 2019)**

- The difference between amylose and amylopectin is

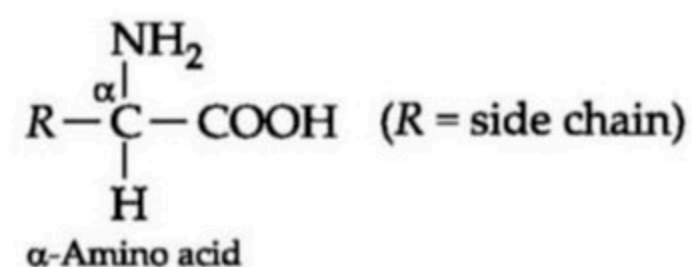
- amylopectin have 1 \rightarrow 4 α -linkage and 1 \rightarrow 6 α -linkage
- amylose have 1 \rightarrow 4 α -linkage and 1 \rightarrow 6 β -linkage
- amylopectin have 1 \rightarrow 4 α -linkage and 1 \rightarrow 6 β -linkage
- amylose is made up of glucose and galactose. **(NEET 2018)**

PROTEINS

- **Proteins** : They are the biomolecules of the living system made up of nitrogenous organic compounds by condensation polymerisation of α -amino acids.

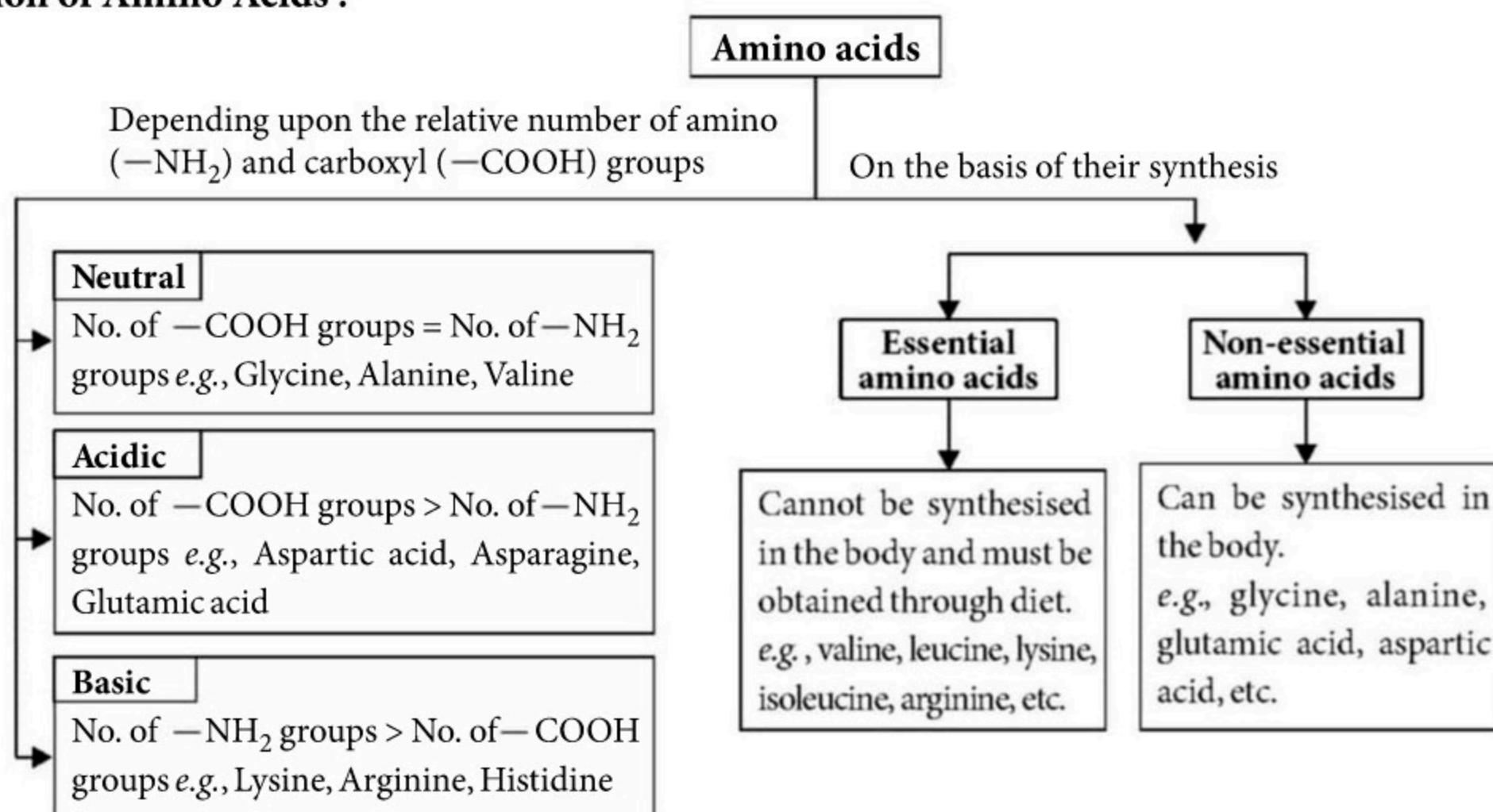
Amino Acids

- Amino acids are the bifunctional molecules with both acidic carboxylic group ($-\text{COOH}$) and basic amino group ($-\text{NH}_2$) and in α -amino acids, the amino ($-\text{NH}_2$) group is at α -position *w.r.t.* carboxylic ($-\text{COOH}$) group. *i.e.*, both amino and carboxylic groups are attached to the same carbon atom.



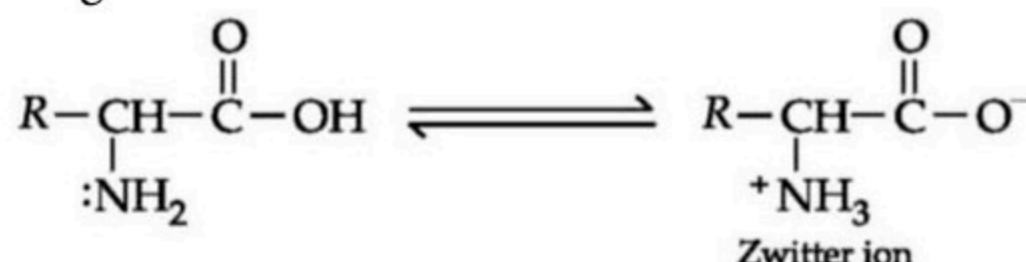
- They are very important as they are the building blocks of proteins.

Classification of Amino Acids :



Properties of Amino Acids

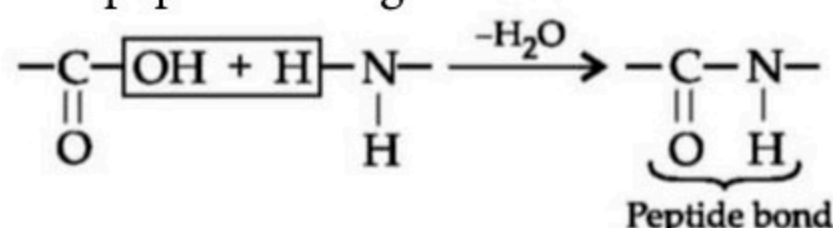
- Amino acids are usually colourless, crystalline, water soluble and high melting solids.
- They behave like salts due to presence of basic amino group ($-\text{NH}_2$) and acidic carboxylic group ($-\text{COOH}$) in the same molecule.
- In aqueous solution, the carboxylic group can lose a proton and amino group can accept a proton giving rise to a dipolar ion known as Zwitter ion. This is neutral but contains both positive and negative charges.



- Isoelectric point** : The pH at which dipolar ion (zwitter ion) exists as neutral ion, *i.e.*, it does not migrate to either electrode, is called isoelectric point. The amino acids have least solubility at isoelectric point which helps in their separation.

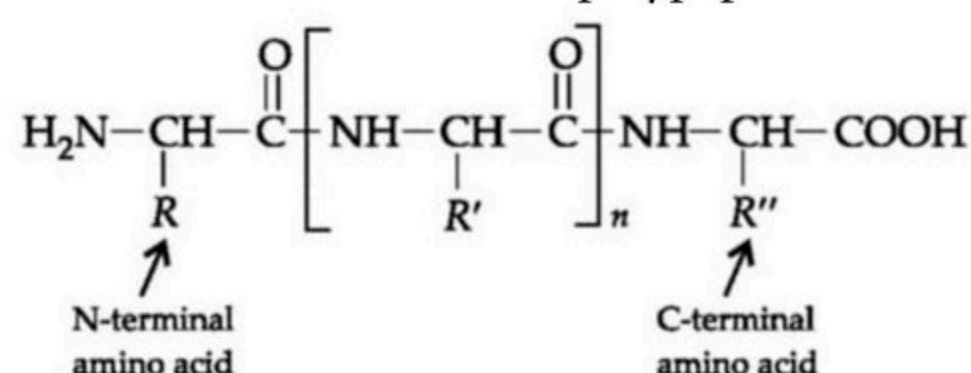
Peptides and their classification

- Peptide bond** : The bond formed between two amino acids by the elimination of a water molecule is called a peptide linkage or bond.



- The products formed by the linking of amino acids by peptide linkage are known as peptides.

- Peptides are further divided into *di*, *tri*, *tetra* depending upon the number of amino acids combined.
- Polypeptides** : Structures with more than ten amino acids are known as polypeptides.



where, R , R' , R'' may be same or different alkyl group.

- A polypeptide with more than hundred amino acid residues, having molecular mass higher than 10,000 u is called a protein.

Classification of Proteins

- Fibrous Proteins** : Fibrous proteins consist of linear thread-like polypeptide chains which lie side by side to form fibres. These polypeptide chains are held together at many points by hydrogen bonds. These are insoluble in water and are stable to moderate changes in pH and temperature, *e.g.*, keratin in skin, hair, nails and wool, collagen in tendons, fibroin in silk and myosin in muscles.
- Globular Proteins** : In these proteins, polypeptide chains are folded around itself forming spheroidal shape and the peptide chains are stabilised by intramolecular hydrogen bonds. Globular proteins are soluble in water and sensitive to small changes in temperature and pH. Examples are hormones (insulin), antibodies, haemoglobin, fibrinogen, albumin, etc.

Structure of Proteins

- **Primary Structure** : Primary structure refers to sequence of amino acids present in a protein molecule.
- **Secondary Structure** : Secondary structure refers to the conformation which the polypeptide chains assume as a result of H-bonding. There are two types of secondary structures :
 - **α -Helix** : In this type of protein, polypeptide chains coil up to form a spiral-like structure. There occurs extensive intermolecular hydrogen bonding between two adjacent turns so that the helix is rigid.
 - **β -pleated sheet structure** : In this structure polypeptide chains are extended and held together by intermolecular hydrogen bond.
- **Tertiary Structure** : Tertiary structure refers to the three dimensional structure of proteins.
- **Quaternary Structure** : It describes the arrangement and ways in which different sub-units are held together.

Denaturation of Protein

- In denaturation, three dimensional structure of proteins changes by change in pH, temperature, presence of salts or certain chemical compounds. Denaturation does not change primary structure but changes secondary and tertiary structures of proteins, *e.g.*, coagulation of albumin present in white part of egg when egg is boiled.

ENZYMES

- The enzymes are biocatalysts produced by living cells which catalyse biochemical reactions in living organisms.
- **Some Common Enzymes :**

Enzymes	Reactions which is catalysed
Amylase	Starch $\rightarrow n \times$ Glucose
Maltase	Maltose $\rightarrow 2 \times$ Glucose
Lactase	Lactose \rightarrow Glucose + galactose
Invertase	Sucrose \rightarrow Glucose + fructose
Pepsin	Proteins \rightarrow Amino acid
Trypsin	Polypeptides \rightarrow Amino acid
Nucleases	DNA, RNA \rightarrow Nucleotides
Urease	Urea \rightarrow $\text{NH}_3 + \text{CO}_2$
Carbonic anhydrase	$\text{H}_2\text{CO}_3 \rightarrow \text{CO}_2 + \text{H}_2\text{O}$

VITAMINS

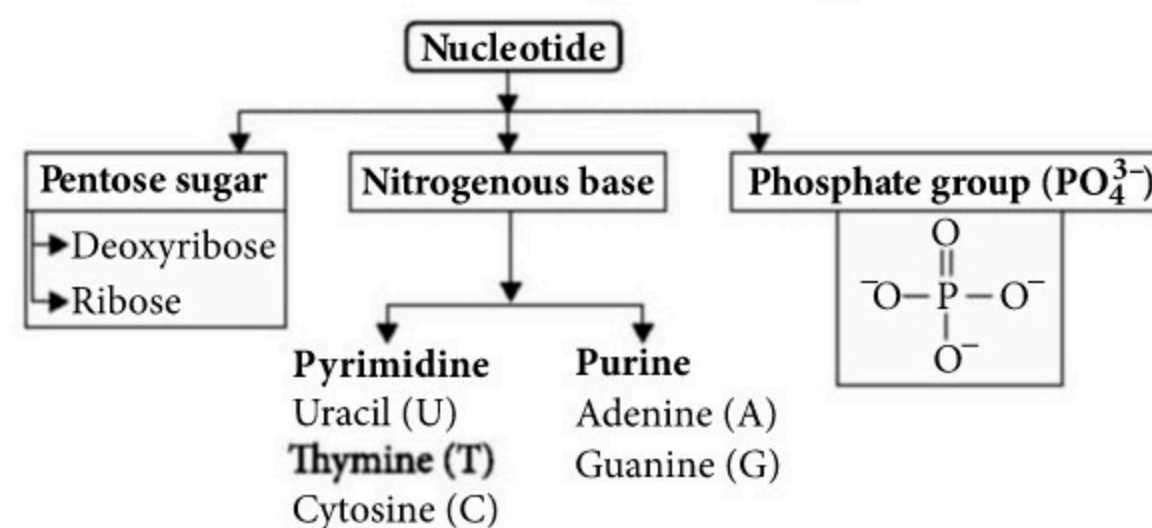
These are biomolecules which cannot be produced by the body and must be supplied in small amounts in diet to carry out essential metabolic reactions which are required for normal growth and maintenance of the body.

Classification

- **Water soluble vitamins** : Must be supplied regularly in diet as they are regularly excreted in urine (except vitamin B_{12}) *e.g.*, Vitamin- B_1 , B_2 , B_6 , B_{12} and C.
- **Fat soluble vitamins** : Stored in liver and adipose tissues *e.g.*, Vitamin - A, D, E and K.
- Biotin (vitamin H), is however neither soluble in water nor in fat.

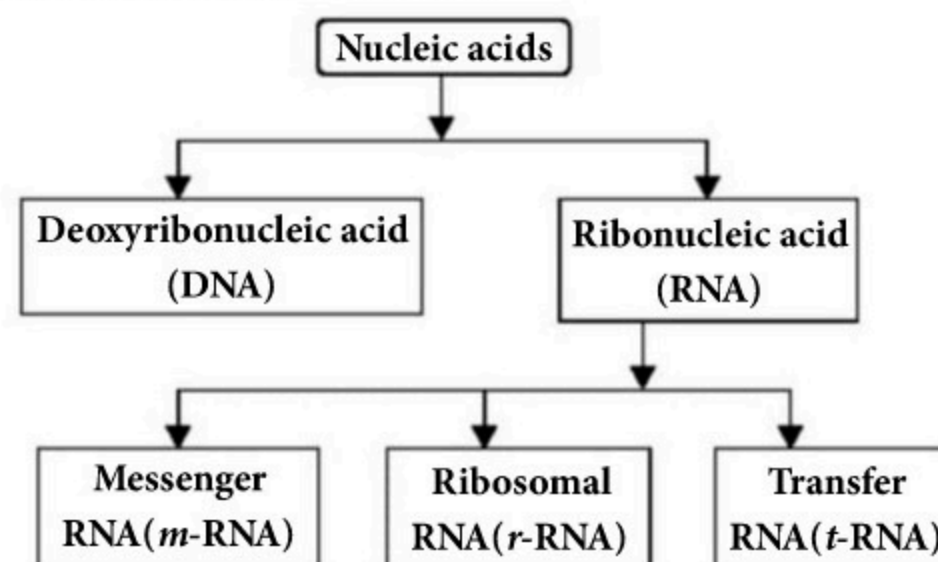
NUCLEIC ACIDS

- Nucleic acids are the biopolymers of nucleotides present in nucleus of all living cells and play an important role in transmission of the hereditary characteristics and biosynthesis of proteins.



- **Nucleoside** : Pentose sugar + a nitrogenous base.

Types of Nucleic Acids



Differences between DNA and RNA

	Deoxyribonucleic acid (DNA)	Ribonucleic acid (RNA)
1.	Occurs in the nucleus of the cell.	Occurs in the cytoplasm.
2.	Sugar present is 2-deoxy-D-(-)-ribose.	Sugar present is D-(-)-ribose.

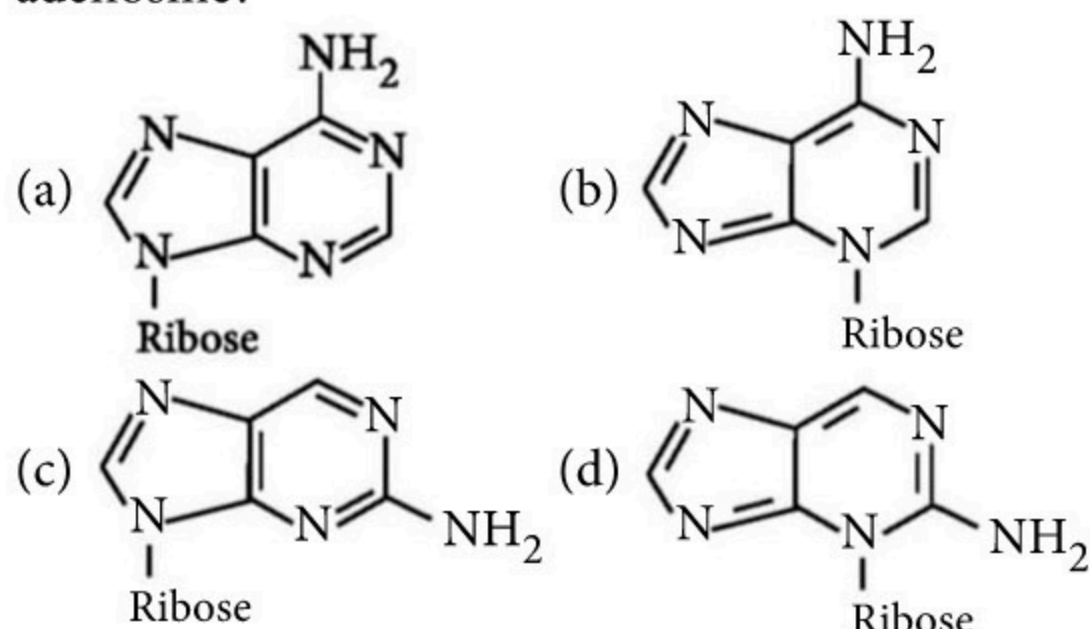
3.	Contains cytosine and thymine as pyrimidine bases, guanine, adenine as purine bases.	Contains cytosine and uracil as pyrimidine bases and guanine and adenine as purine bases.
4.	Double-stranded α -helix structure.	Single-stranded α -helix structure.
5.	Undergoes replication.	Does not undergo replication.

HORMONES

- **Hormones** : They are the molecules that act as intercellular messengers and are poured directly in the blood stream by endocrine glands.
- **Types of hormones** :
 - **Steroids** : Estrogens and androgens
 - **Polypeptides** : Insulin and endorphins
 - **Amino acid derivatives** : Epinephrine and norepinephrine.

PEEP INTO PREVIOUS YEARS

8. The increasing order of pK_a of the following amino acids in aqueous solution is Gly, Asp, Lys, Arg
 (a) Arg < Lys < Gly < Asp
 (b) Asp < Gly < Lys < Arg
 (c) Asp < Gly < Arg < Lys
 (d) Gly < Asp < Arg < Lys (JEE Main 2019)
9. Which of the following is the correct structure of adenosine?



(JEE Main Online 2018)

10. The correct statement regarding RNA and DNA, respectively is
 (a) the sugar component in RNA is a arabinose and the sugar component in DNA is ribose

- (b) the sugar component in RNA is 2'-deoxyribose and the sugar component in DNA is arabinose
 (c) the sugar component in RNA is arabinose and the sugar component in DNA is 2'-deoxyribose
 (d) the sugar component in RNA is ribose and the sugar component in DNA is 2'-deoxyribose.

(NEET-I 2016)

POINTS FOR EXTRA SCORING


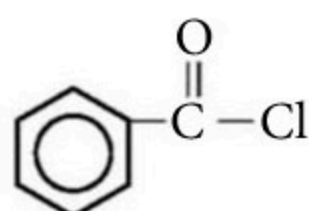
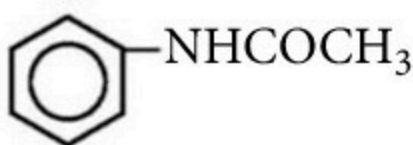


- **Biuret Test** : On adding few drops of copper sulphate solution to an alkaline solution of protein, a bluish violet colour develops. This test is basically for peptide linkage.
- **Millon's Test** : Proteins give a white precipitate with Millon's base which changes to red upon heating. Millon's reagent is prepared by dissolving an equal amount of mercuric and mercurous nitrate in distilled water.
- **Ninhydrin Test** : Protein and α -amino acids give a blue or violet colour with ninhydrin (indane-1,2,3-trione).
- When cellulose is treated with concentrated NaOH solution, it forms a gelatinous semi-transparent mass which imparts lustre to cotton (mercerised) and this process is called mercerisation.
- The most widely used method for determining the N-terminal amino acid residue in a protein or a polypeptide molecule is called the DNP-method or Sanger's method.
- The most widely used method for determining the C-terminal amino acid residue in a protein or a polypeptide is called hydrazinolysis.
- Sequence of three bases in *t*-RNA molecule is known as anticodon and useful during protein synthesis.
- Separation of DNA strands on heating known as melting and hybridisation again on cooling is known as annealing.

Answer Key For Peep Into Previous Years

- | | | | | | | | | | | | |
|----|-----|----|-----|----|-----|-----|-----|----|-----|----|-----------|
| 1. | (b) | 2. | (b) | 3. | (d) | 4. | (a) | 5. | (c) | 6. | (a, b, c) |
| 7. | (a) | 8. | (b) | 9. | (a) | 10. | (d) | | | | |

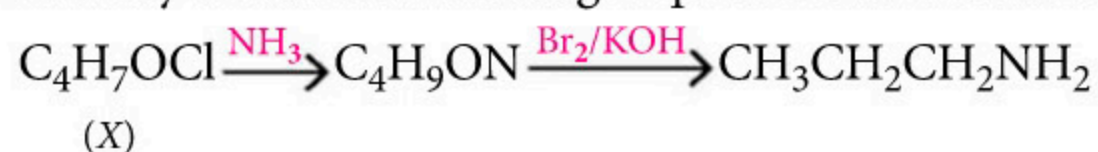


WRAP it up!

1. Nitrobenzene can be prepared by oxidizing aniline by
(a) H_2SO_4 (b) H_2SO_5
(c) H_2SO_3 (d) $\text{K}_2\text{Cr}_2\text{O}_7/\text{H}^+$
2. The dipeptide glycylalanine contains
(a) glycine as C-terminal residue
(b) glycine as N-terminal residue
(c) alanine as N-terminal residue
(d) either (a) or (b).
3. Which type of hybridised C-atoms are present in $\text{C}(\text{CN})_4$?
(a) sp , sp^3 (b) sp^2 , sp^3
(c) sp^2 , sp (d) sp^2 , sp , sp^3
4. The compound which on reaction with aqueous nitrous acid at low temperature produces an oily nitrosoamine is
(a) methylamine (b) ethylamine
(c) diethylamine (d) triethylamine.
5. Polypeptides having, molecular weights above 10,000 are known as
(a) amino acids (b) hormones
(c) proteins (d) nucleotides.
6. Arrange the following in increasing order of their basic strength :
 CH_3NH_2 (I), $(\text{CH}_3)_2\text{NH}$ (II), $(\text{CH}_3)_3\text{N}$ (III),
 $\text{C}_6\text{H}_5\text{CH}_2\text{NH}_2$ (IV),
(a) $\text{IV} < \text{III} < \text{II} < \text{I}$ (b) $\text{IV} < \text{III} < \text{I} < \text{II}$
(c) $\text{I} < \text{II} < \text{III} < \text{IV}$ (d) $\text{IV} < \text{III} < \text{I} = \text{II}$
7. The segment of DNA which acts as the instrumental manual for the synthesis of the protein is
(a) ribose (b) gene
(c) nucleoside (d) nucleotide.
8. An organic compound with molecular formula $\text{C}_3\text{H}_5\text{N}$ on hydrolysis forms an acid which reduces Fehling's solution. The compound can be
(a) ethane nitrile (b) ethyl carbylamine
(c) ethoxyethane (d) propane nitrile.
9. Aniline reacts with phosgene to form
- (a)  (b) 
(c)  (d) 
10. Two vitamins absorbed from intestine along with fats are
(a) A, D (b) A, B (c) A, C (d) B, D
11. When aniline reacts with NaNO_2 and dil. HCl at $0-5^\circ\text{C}$, the product formed is
(a) nitroaniline
(b) benzene diazonium chloride
(c) benzene (d) trinitroaniline.
12. The solubility of $\text{C}_6\text{H}_5\text{NH}_3^+\text{Cl}^-$ would be highest, among the following solvents in
(a) acidic buffer of $\text{pH} = 3$
(b) basic buffer of $\text{pH} = 10$
(c) pure water.
(d) none of these
13. Match Column I with Column II and select the correct option.
- | Column I | Column II |
|---------------------------|-------------------------|
| I. Anti beri-beri factor | A. Vitamin C |
| II. Pancreas | B. Glycerides |
| III. Palm oil | C. Vitamin B_1 |
| IV. $L(+)$ -Ascorbic acid | D. Insulin |
- (a) I—C; II—D; III—B; IV—A
(b) I—C; II—D; III—A; IV—B
(c) I—A; II—B; III—D; IV—C
(d) I—C; II—B; III—A; IV—D
14. Acetone may be obtained from starch by the action of
(a) acid (b) bacteria
(c) oxidizing agent (d) none of these.
15. In the reduction of nitrobenzene in acidic medium, which of the following is the intermediate?
(a) $\text{C}_6\text{H}_5-\text{N}=\text{O}$ (b) $\text{C}_6\text{H}_5\text{NH}-\text{NHC}_6\text{H}_5$
(c) $\text{C}_6\text{H}_5-\text{N}=\text{N}-\text{C}_6\text{H}_5$
(d) 

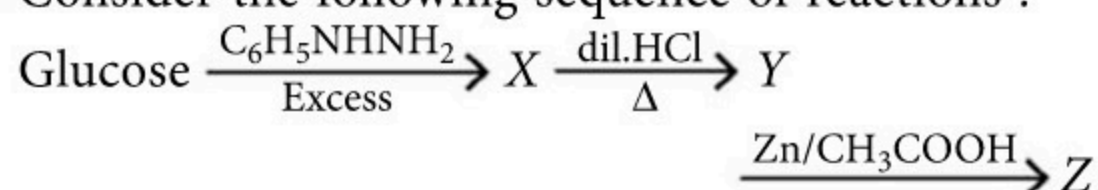
16. If K_1 and K_2 are the ionization constants of $\text{H}_3\text{N}^+\text{CHR}\text{COOH}$ and $\text{H}_3\text{N}^+\text{CHR}\text{COO}^-$, respectively, the pH of the solution at the isoelectric point is
 (a) $\text{pH} = \text{p}K_1 + \text{p}K_2$ (b) $\text{pH} = (\text{p}K_1 + \text{p}K_2)^{1/2}$
 (c) $\text{pH} = (\text{p}K_1 + \text{p}K_2)^{1/2}$ (d) $\text{pH} = (\text{p}K_1 + \text{p}K_2)/2$

17. Identify 'X' in the following sequence of reactions :



- (a) $(\text{CH}_3)_2\text{CHCOCl}$
 (b) $\text{CH}_3\text{CH}_2\text{CH}(\text{OH})\text{CH}_2\text{Cl}$
 (c) $\text{CH}_3\text{CH}_2\text{CH}_2\text{COCl}$
 (d) $\text{ClCH}_2\text{CH}_2\text{CH}_2\text{CHO}$

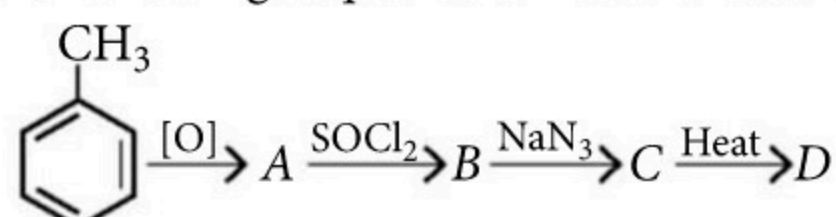
18. Consider the following sequence of reactions :



The final product (Z) is

- (a) sorbitol (b) fructose
 (c) mannose (d) mannitol.
19. Benzamide can be converted to benzonitrile with
 (a) H_3O^+ (b) $\text{OH}^-/\text{H}_2\text{O}$
 (c) KCN (d) P_2O_5 , heat.

20. In the following sequence of reactions, what is D?



- (a) Primary amine
 (b) An amide
 (c) Phenyl isocyanate
 (d) Ethyl benzene

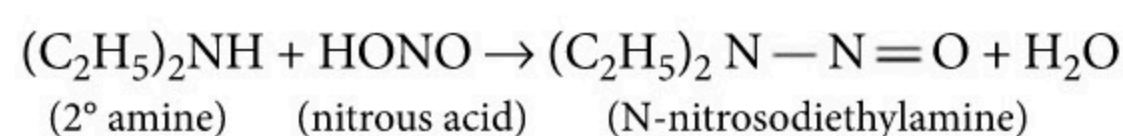
SOLUTIONS

1. (b)
 2. (b): By convention, the name of any polypeptide is written starting from the N-terminal residue. Thus, in glycylalanine, glycine is the N-terminal amino acid residue.

3. (a): $\text{N} \equiv \text{C} - \text{C}(\text{N} \equiv \text{C})_2 - \text{C} \equiv \text{N}$

By structure it is clear that middle carbon is in sp^3 -hybridised state as it has four bond around it and rest four C-atoms of $-\text{C} \equiv \text{N}$ group are in sp -hybridised state as each contains two σ and two π bonds around it.

4. (c): Secondary (2°) amines (aliphatic as well as aromatic) react with nitrous acid (HNO_2) to form N-nitrosoamines.

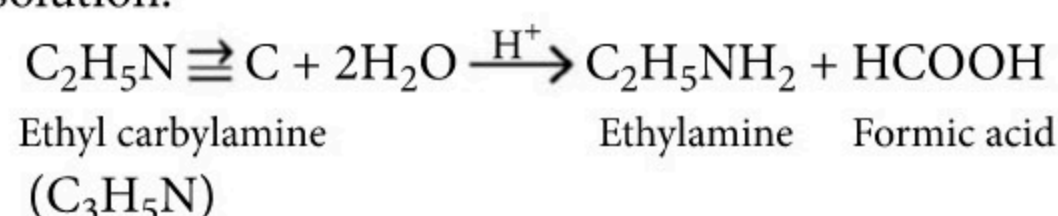


5. (c)

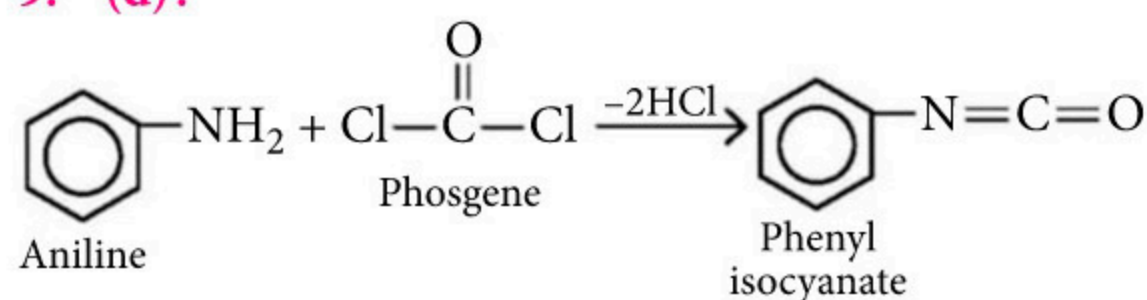
6. (b): The basicity of methylamines increases in the order : $3^\circ < 1^\circ < 2^\circ$, i.e., $\text{III} < \text{I} < \text{II}$. $\text{C}_6\text{H}_5\text{CH}_2\text{NH}_2$, however, is least basic due to $-I$ -effect of the $-\text{C}_6\text{H}_5$ group. Thus, the increasing order of basic character is : $\text{IV} < \text{III} < \text{I} < \text{II}$.

7. (b): Genes are responsible for protein synthesis.

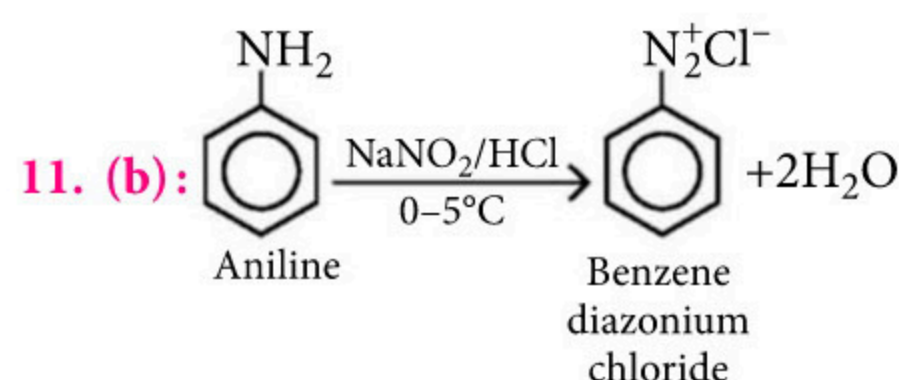
8. (b): Carbylamines on hydrolysis always give HCOOH as one of the products which reduces Fehling's solution.



9. (d):



10. (a): Vitamins A, D are absorbed from the intestine along with fats.



12. (b): The solubility of $\text{C}_6\text{H}_5\text{NH}_3^+\text{Cl}^-$ is in the order : highest in basic solution, then in pure water and then in an acidic solution.

13. (a): Deficiency of vitamin B_1 causes beri-beri, that's why this is known as anti beri-beri factor. Insulin is released from pancreas. Palm oil contains glycerides. $L(+)$ -Ascorbic acid is the chemical name for vitamin C.

14. (b): Starch on bacterial action produces acetone as one product.

15. (a): In the reduction of nitrobenzene, nitrosobenzene ($\text{C}_6\text{H}_5-\text{N}=\text{O}$) and phenyl hydroxylamines ($\text{C}_6\text{H}_5-\text{NHOH}$) are obtained as intermediate in acidic medium.

and f-Block Elements

f-Block Elements

- Inner transition elements.
- The f-block consists of two series of elements known as lanthanides (lanthanoids) and actinides (actinoids).
- E.C.: $(n-2)f^{1-14}(n-1)d^{0-1}ns^2$ (where, $n = 6$ for lanthanides and $n = 7$ for actinides).

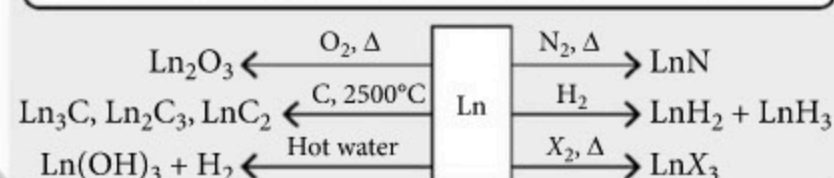
Trends and Characteristics of Lanthanides

- Show common stable oxidation state +3.
- Regular decrease in atomic and ionic radii with increase in atomic number is called lanthanide contraction.
- They have low I.E. and high b.pt. and m.pt.
- All the lanthanides are strong reducing agents.

Trends and Characteristics of Actinides

- All actinides show +3 common oxidation state.
- All actinides are radioactive.
- All are strong reducing agents.

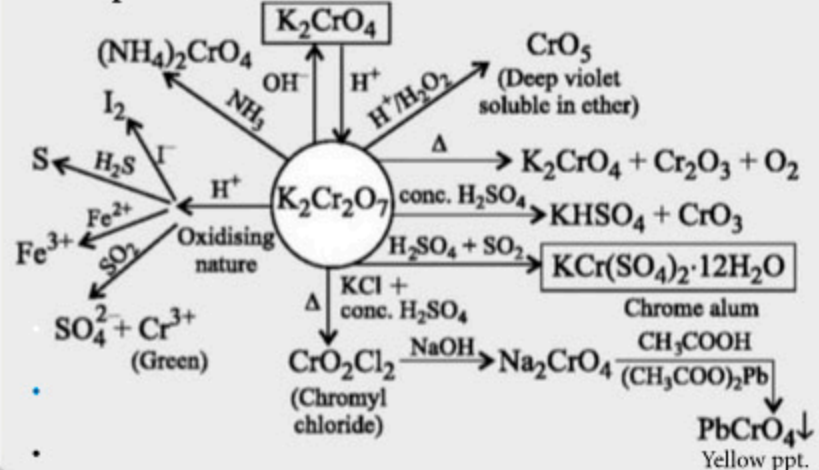
Chemical Reactivity of Lanthanides



K₂Cr₂O₇ (Potassium dichromate)

- **Preparation:** $4\text{FeCr}_2\text{O}_4 + 8\text{Na}_2\text{CO}_3 + 7\text{O}_2 \rightarrow 8\text{Na}_2\text{CrO}_4 + 2\text{Fe}_2\text{O}_3 + 8\text{CO}_2$
 $\text{Na}_2\text{CrO}_4 \xrightarrow[\text{(ii) KCl}]{\text{(i) Conc. H}_2\text{SO}_4} \text{K}_2\text{Cr}_2\text{O}_7 + 2\text{NaCl}$

Properties:



Coordination Compounds

Werner's Coordination Theory

It explains the nature of bonding in complexes. Metals show two different kind of valencies:

- **Primary valency:** Non-directional and ionisable. It is equal to the oxidation state of the central metal ion. It is satisfied by negative ions.
- **Secondary valency:** Directional and non-ionisable. It is equal to the coordination number of the metal. It is commonly satisfied by neutral and negatively charged ions.

Valence Bond Theory (VBT)

- Bonding in terms of hybridised orbitals of the central metal atom or ion, it explains the shapes and magnetic behaviour of complexes.
- **Hybridisation and geometry of complexes:**

Coordination no.	Type of hybridisation	Geometry of complex
4	sp^3	Tetrahedral
4	dsp^2	Square planar
5	sp^3d	Trigonal bipyramidal
6	sp^3d^2	Octahedral
6	d^2sp^3	Octahedral

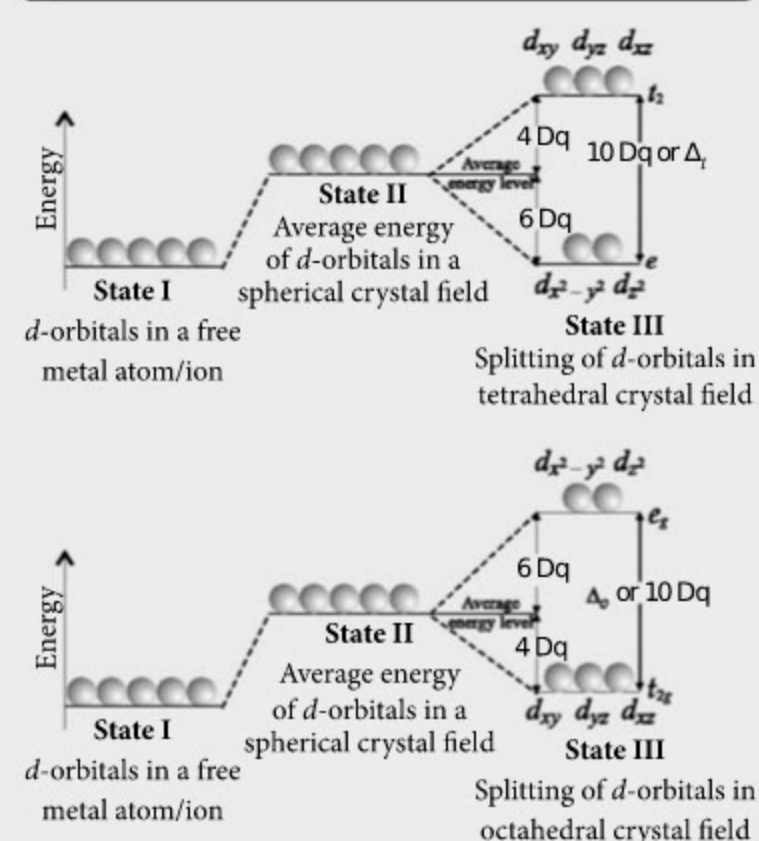
Isomerism

- **Structural isomerism:** Arises due to difference in structures of coordination compounds.
 - **Isonisation isomerism:** $[\text{Co}(\text{NH}_3)_5\text{Br}]\text{Cl}$; $[\text{Co}(\text{NH}_3)_5\text{Cl}]\text{Br}$
 - **Hydrate isomerism:** $[\text{Cr}(\text{H}_2\text{O})_6]\text{Cl}_3$; $[\text{CrCl}(\text{H}_2\text{O})_5]\text{Cl}_2 \cdot \text{H}_2\text{O}$; $[\text{CrCl}_2(\text{H}_2\text{O})_4]\text{Cl} \cdot 2\text{H}_2\text{O}$
 - **Coordination isomerism:** $[\text{Co}(\text{NH}_3)_6][\text{Cr}(\text{CN})_6]$; $[\text{Cr}(\text{NH}_3)_6][\text{Co}(\text{CN})_6]$
 - **Linkage isomerism:** $[\text{Co}(\text{NH}_3)_5\text{ONO}]\text{Cl}_2$; $[\text{Co}(\text{NH}_3)_5\text{NO}_2]\text{Cl}_2$
- **Stereoisomerism:** Shown by compounds having same structural formula but differ only in the spatial arrangement of ligands around the central atom.
 - **Geometrical isomerism:** Arises due to different possible geometric arrangement of ligands.
 - **Optical isomerism:** Shown by molecule which do not have plane of symmetry.

Crystal Field Theory (CFT)

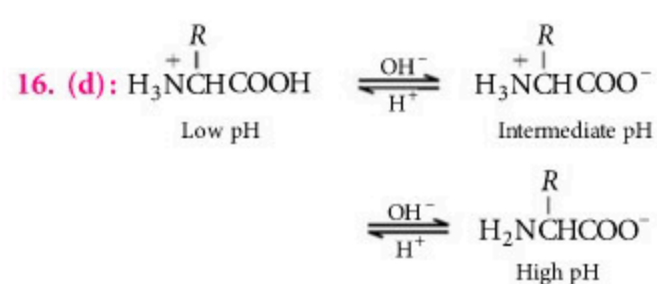
- According to CFT, under the influence of ligand field, degeneracy of d-orbitals is destroyed and they split into two or more energy levels. The extent of splitting depends upon the strength of ligand.
- **Spectrochemical series:** Arrangement of ligands in the order of increasing field strength (increasing order of Δ_o).
 $\text{I}^- < \text{Br}^- < \text{S}^{2-} < \text{SCN}^- < \text{Cl}^- < \text{F}^- < \text{OH}^- < \text{C}_2\text{O}_4^{2-} < \text{H}_2\text{O} < \text{NCS}^- < \text{NH}_3 < \text{en} < \text{NO}_2^- < \text{CN}^- < \text{CO}$.
 – If $\Delta_o < p$, then complex is high spin.
 – If $\Delta_o > p$, then complex is low spin; $\Delta_t = 4/9 \Delta_o$

Splitting of d-orbitals in Tetrahedral and Octahedral Crystal Field



Applications of Coordination Compounds

- In biological system. e.g., chlorophyll, haemoglobin, vitamin B₁₂, etc. are coordinate compounds of Mg, Fe and Co respectively.
- *cis*-platin is used in cancer treatment, EDTA is often used for treatment of lead poisoning.



$$K_1 = \frac{[\text{H}_3\text{N}^+\text{CHR}(\text{COO}^-)][\text{H}^+]}{[\text{H}_3\text{N}^+\text{CHR}(\text{COOH})]},$$

$$K_2 = \frac{[\text{H}_2\text{NCHR}(\text{COO}^-)][\text{H}^+]}{[\text{H}_3\text{N}^+\text{CHR}(\text{COO}^-)]}$$

$$\text{Thus, } K_1 K_2 = \frac{[\text{H}_2\text{NCHR}(\text{COO}^-)][\text{H}^+]^2}{[\text{H}_3\text{N}^+\text{CHR}(\text{COOH})]}$$

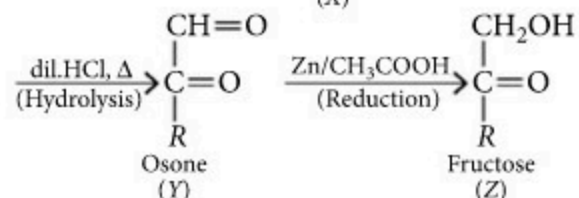
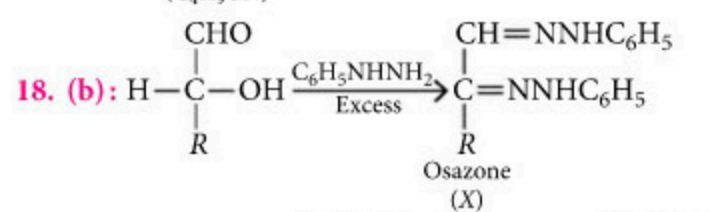
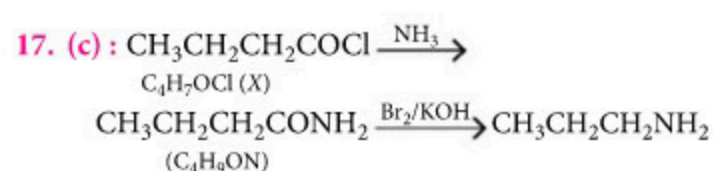
At the isoelectric point,
 $[\text{H}_2\text{NCHR}(\text{COO}^-)] = [\text{H}_3\text{N}^+\text{CHR}(\text{COOH})]$
 $K_1 K_2 = [\text{H}^+]^2$

$$2\log [\text{H}^+] = \log K_1 + \log K_2$$

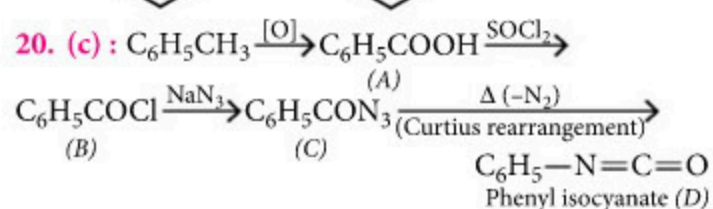
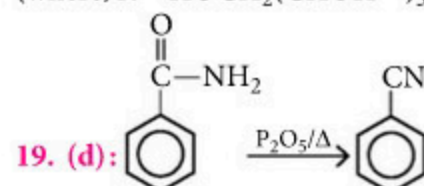
$$-2\log [\text{H}^+] = -\log K_1 - \log K_2$$

$$2\text{pH} = \text{p}K_1 + \text{p}K_2$$

$$\text{pH} = (\text{p}K_1 + \text{p}K_2)/2$$



(where, $\text{R} = \text{HOCH}_2(\text{CHOH})_3$)



Scientist who Made Us Proud

Homi Nusserwanji Sethna was an Indian nuclear scientist and a chemical engineer, gaining international fame as the Chairman of the Atomic Energy Commission (India) during the time when the first nuclear test, code name Smiling Buddha in Pokhran Test Range in 1974 was conducted. He was the primary and central figure in India's civilian nuclear program as well as the construction of nuclear power plants.



Homi Nusserwanji Sethna
(24 Aug. 1923 - 5 Sep. 2010)

Biography

Sethna was born to a Parsi family on 24 August 1923 in Mumbai. He did his schooling from St. Xavier's High School, Fort, Mumbai and higher studies from the University of Michigan Ann Arbor. Earlier in his career, he had full technical responsibility for setting up of the Thorium extraction plant at Alwaye, Kerala India, for separation of rare earth from monazite sands.

He completed the construction of the Thorium plant and the plant for the production of nuclear grade uranium metal at Trombay, India. His first major challenging assignment was the setting up of the Plutonium Plant at Trombay

in 1959. This was designed and constructed entirely by Indian scientists and engineers under H. N. Sethna as the Project Engineer. The Uranium Mill at Jaduguda, Jharkhand was also constructed under his guidance in 1967. He was also the Project Manager of a 40 MW reactor called Canada-India Reactor in 1956-58.

Honors

- He was the guiding force behind the first peaceful nuclear explosion, Project Smiling Buddha in India on 18 May 1974, and in 1975, Homi Sethna, then chairman of the Atomic Energy Commission, Raja Ramanna and Basanti Dulal Nagchaudhuri (head of the DRDO) received the Padma Vibhushan.
- He was formerly Chairman of Atomic Energy Commission, in 1976 he became the first chairman of Maharashtra Academy of Sciences, located in Pune, Maharashtra.

Awards

- 1959: Padma Shri
- 1960: SS Bhatnagar Prize
- 1966: Padma Bhushan
- 1967: University of Michigan Sesquicentennial Award
- 1975: Padma Vibhushan



CBSE

warm-up!

CLASS-XII

Practice questions for CBSE Exams as per the latest pattern
and marking scheme issued by CBSE for the academic session 2019-20.

Practice Paper 2020

Time Allowed : 3 hours
Maximum Marks : 70

GENERAL INSTRUCTIONS

- All questions are compulsory.
- Section A: Q.no. 1 to 20 are very short answer questions (objective type) and carry 1 mark each.
- Section B: Q.no. 21 to 27 are short answer questions and carry 2 marks each.
- Section C: Q.no. 28 to 34 are long answer questions and carry 3 marks each.
- Section D: Q.no. 35 to 37 are also long answer questions and carry 5 marks each.
- There is no overall choice. However an internal choice has been provided in two questions of two marks, two questions of three marks and all the three questions of five marks weightage. You have to attempt only one of the choices in such questions.
- Use log tables if necessary, use of calculators is not allowed.

SECTION - A

Read the given passage and answer the questions 1 to 5 that follow :

Amines have an unshared pair of electrons on nitrogen atom hence amines behave as a Lewis base. The basic character of amines can be expressed in terms of their K_b and pK_b values. Aliphatic amines are stronger bases than ammonia because +I effect of alkyl groups increases electron density on nitrogen atom.

- Out of 1° amine, 2° amine and 3° amine, which one of the amine is strongest base in non-aqueous solvents?
- Write the increasing order of basicity of amines (in gaseous phase) of the given compounds : $(CH_3)_2NH$, NH_3 , $(CH_3)_3N$, CH_3NH_2 .
- Write the factors on which basicity of amines depends in aqueous solution.
- Why amines are more basic than alcohols?
- Why pK_b of aniline is more than that of methylamine?

Questions 6 to 10 are one word answers :

- Name a substance that can be used as an antiseptic as well as a disinfectant.
- Which law gives the relation between solubility of a gas and pressure?
- Give one example of positively charged sol.
- Name the process which is used for removal of gangue or matrix from the ore.
- Which halogen compound in each of the following pairs will react faster in S_N2 reaction : CH_3Br or CH_3I

Questions 11 to 15 are multiple choice questions :

- The specific conductance of a saturated solution of $AgCl$ at 25 °C is $1.821 \times 10^{-5} \text{ mho cm}^{-1}$. What is the solubility of $AgCl$ in water (in g L^{-1}), if limiting molar conductivity of $AgCl$ is $130.26 \text{ mho cm}^2 \text{ mol}^{-1}$?
(a) $1.89 \times 10^{-3} \text{ g L}^{-1}$ (b) $2.78 \times 10^{-2} \text{ g L}^{-1}$
(c) $2.004 \times 10^{-2} \text{ g L}^{-1}$ (d) $1.43 \times 10^{-3} \text{ g L}^{-1}$

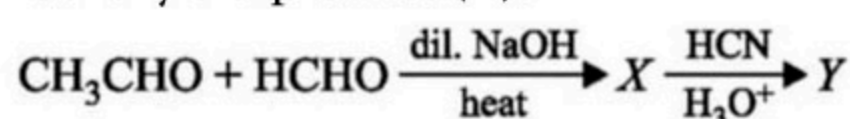
12. Which of the following statements is not correct?

- (a) For a zero order reaction, $t_{1/2}$ is proportional to initial concentration.
 (b) The relationship of variation of rate constant with temperature is given by $\log \frac{k_2}{k_1} = \frac{E_a}{2.303R} \left[\frac{T_2 - T_1}{T_1 T_2} \right]$
 (c) The unit of rate constant for a reaction is $\text{mol}^{1-n} \text{L}^{n-1} \text{s}^{-1}$ where n is order of the reaction.
 (d) The unit of rate of reaction changes with order of reaction.

13. A compound $\text{C}_6\text{H}_{14}\text{O}_2$ has two tertiary alcoholic groups. The IUPAC name of this compound is

- (a) 2, 3-dimethyl - 1, 2-butanediol
 (b) 3, 3-dimethyl - 1, 2-butanediol
 (c) 2, 3-dimethyl - 2, 3-butanediol
 (d) 2-methyl - 2, 3-pentanediol.

14. Study the following sequence of reactions and identify the product (Y).



- (a) $\text{CH}_2=\text{CH}-\underset{\text{OH}}{\text{CH}}-\text{COOH}$
 (b) $\text{CH}_3-\underset{\text{OH}}{\overset{\text{CN}}{\text{C}}}-\text{COOH}$
 (c) $\text{CH}_3\text{CH}_2-\underset{\text{OH}}{\text{CH}}-\text{COOH}$
 (d) $\text{CH}_2=\text{CH}-\underset{\text{CN}}{\text{CH}}-\text{COOH}$

15. Which of the following pairs of isomers is not correctly matched with its type of isomerism?

- (a) $[\text{Cr}(\text{NH}_3)_6]$ $[\text{Cr}(\text{CN})_6]$ and $[\text{Cr}(\text{NH}_3)_4(\text{CN})_2]$ $[\text{Cr}(\text{NH}_3)_2(\text{CN})_4]$
 – Coordination isomerism
 (b) $[\text{Co}(\text{NH}_3)_5\text{NO}_2]\text{Cl}_2$ and $[\text{Co}(\text{NH}_3)_5\text{ONO}]\text{Cl}_2$
 – Linkage isomerism
 (c) $[\text{Co}(\text{py})_2(\text{H}_2\text{O})_2\text{Cl}_2]\text{Cl}$ and $[\text{Co}(\text{py})_2(\text{H}_2\text{O})\text{Cl}_3]$
 H_2O – Coordination isomerism
 (d) $[\text{Pt}(\text{NH}_3)_4\text{Br}_2]\text{Cl}_2$ and $[\text{Pt}(\text{NH}_3)_4\text{Cl}_2]\text{Br}_2$
 – Ionisation isomerism

Questions 16 to 20 :

- (a) Both assertion and reason are correct statements, and reason is the correct explanation of the assertion.

- (b) Both assertion and reason are correct statements, but reason is not the correct explanation of the assertion.
 (c) Assertion is correct, but reason is wrong statement.
 (d) Assertion is wrong, but reason is correct statement.

16. **Assertion :** $\text{S}_{\text{N}}2$ reaction proceeds with racemisation while $\text{S}_{\text{N}}1$ reaction proceeds with complete stereochemical inversion.

Reason : $\text{S}_{\text{N}}2$ is one step reaction while $\text{S}_{\text{N}}1$ is two steps reaction.

17. **Assertion :** The two strands of DNA are complementary to each other.

Reason : Adenine specifically forms hydrogen bonds with guanine whereas cytosine forms hydrogen bonds with thymine.

18. **Assertion :** The relative ease of dehydration of alcohols follows the following order :

Tertiary > Secondary > Primary

Reason : Formation of carbocation is the slowest step of the reaction.

19. **Assertion :** Magnetic moment of Mn^{2+} is higher than that of Cr^{2+} .

Reason : Higher the atomic number smaller is the magnetic moment.

20. **Assertion :** HClO_4 is a stronger acid than HClO_3 .

Reason : Oxidation state of chlorine in HClO_4 is +7 and in HClO_3 is +5.

SECTION - B

21. What are polydienes? Give one example.

22. Discuss the effect of pressure and temperature on the adsorption of gases on solids.

23. (a) What is the role of cryolite in the metallurgy of aluminium?

(b) Which is a better reducing agent at 710°C , C or CO?

OR

What is the thermodynamic consideration in the choice of a reducing agent in metallurgy?

24. Write two differences between 'order of reaction' and 'molecularity of reaction'. (Delhi 2014, 2011C)

25. 0.90 g of a non-electrolyte was dissolved in 87.90 g of benzene. This raised the boiling point of benzene by 0.25°C . If the molecular mass of the non-electrolyte is 103.0 g mol^{-1} . Calculate the molar elevation constant for benzene.

OR

What is the molar concentration of solute particle in human blood if the osmotic pressure is 7.2 atm at the body temperature of 37°C ? [$R = 0.0821 \text{ L atm K}^{-1}$]

26. Differentiate between nucleotides of DNA and RNA.
27. How do antiseptics differ from disinfectants? Give one example of each.

SECTION - C

28. Write chemical reactions for :
- n*-butyl chloride is treated with alcoholic KOH.
 - bromobenzene is treated with CH_3Cl in the presence of anhydrous AlCl_3 .
 - chlorobenzene is subjected to hydrolysis.
 - ethyl chloride is treated with aqueous KOH.
 - methyl bromide is treated with sodium in the presence of dry ether.
 - methyl chloride is treated with KCN?
29. (a) What is meant by chelate effect? Give an example.
- (b) What will be the correct order for the wavelengths of absorption in the visible region of the following?
 $[\text{Ni}(\text{NO}_2)_6]^{4-}$, $[\text{Ni}(\text{NH}_3)_6]^{2+}$, $[\text{Ni}(\text{H}_2\text{O})_6]^{2+}$

OR

Write the hybridisation and magnetic character of the following complexes:

- $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$
 - $[\text{Ni}(\text{CN})_4]^{2-}$
- [Atomic number : Fe = 26, Ni = 28]
30. Account for the following :
- Transition metals form large number of complex compounds.
 - The lowest oxide of transition metal is basic whereas the highest oxide is amphoteric or acidic.
 - E° value for the $\text{Mn}^{3+}/\text{Mn}^{2+}$ couple is highly positive (+1.57 V) as compared to $\text{Cr}^{3+}/\text{Cr}^{2+}$.
- (Delhi 2017)
31. Explain the following observations :
- The boiling point of ethanol is higher than that of methoxymethane.
 - Phenol is more acidic than ethanol.
 - ortho*-Nitrophenol is more acidic than *ortho*-methoxyphenol.

OR

- Write mechanism of the following reaction :

$$\text{C}_2\text{H}_5\text{OH} \xrightarrow[443\text{ K}]{\text{H}_2\text{SO}_4} \text{CH}_2 = \text{CH}_2 + \text{H}_2\text{O}$$
 - Why does phenol undergo electrophilic substitution more easily than benzene?
- (Delhi 2019)

- With the help of chemical equation explain the principle of Contact process in brief for the manufacture of sulphuric acid.
 - Draw the structure of $\text{H}_2\text{S}_2\text{O}_8$.
 (AI 2019, AI 2017, Foreign 2014, 2011, Delhi-2013,12)
33. Explain why
- Cu^{2+} salts are coloured while Zn^{2+} salts are white.
 - Ce^{3+} can be easily oxidised to Ce^{4+} .
 (At. no. Ce = 58)
 - In a transition series of metals, the metal which exhibits the greatest number of oxidation states occurs in the middle of the series.
34. The vapour pressures of ethanol and methanol are 44.5 mm Hg and 88.7 mm Hg respectively at a particular temperature. An ideal solution is formed at the same temperature by mixing 60 g of ethanol with 40 g of methanol. Calculate the total vapour pressure of the solution and mole fraction of methanol in the vapour phase.

SECTION - D

35. (a) Two elements of the same group combine to form the compounds of the type AA' , AA'_3 and AA'_5 . Draw the structures of each type, showing number of lone pairs and bond pairs. Give examples.
- (b) Explain :
- Hydrides of oxygen family are acidic in nature and acidic character increases down the group.
 - In interhalogen compounds of the type AB_5 and AB_7 , B is invariably fluorine.
- OR
- Give the formula and describe the structure of a noble gas species which is isostructural with :
 (i) ICl_4^- (ii) BrO_3^-
 - Does the hydrolysis of XeF_6 lead to a redox reaction?
 - What happens when Cl_2 reacts with hot concentrated solution of sodium hydroxide? Is this reaction a disproportionation reaction?
36. (a) Give a plausible explanation for each one of the following :
- There are two $-\text{NH}_2$ groups in semicarbazide. However, only one such group is involved in the formation of semicarbazones.
 - Cyclohexanone forms cyanohydrins in good yield but 2,4,6-trimethylcyclohexanone does not.

- OR

- $$\begin{array}{c} \text{C}_6\text{H}_6 \xrightarrow[\text{Anhyd. AlCl}_3]{\text{CH}_3\text{COCl}} \text{A} \xrightarrow{\text{Zn-Hg/conc. HCl}} \text{B} \\ \downarrow \text{NaOI} \quad \quad \quad \downarrow \begin{array}{l} \text{(i) KMnO}_4 / \text{KOH}, \Delta \\ \text{(ii) H}_3\text{O}^+ \end{array} \\ \text{D} + \text{E} \quad \quad \quad \text{C} \end{array}$$

(Delhi 2016)

- (ii) $\text{HNO}_3/\text{H}_2\text{SO}_4$ (at 273 – 383 K).

- (b) The resistance of a conductivity cell containing 0.001 M KCl solution at 298 K is $1500\ \Omega$. What is the cell constant if the conductivity of 0.001 M KCl solution at 298 K is $0.146 \times 10^{-3}\ \text{S cm}^{-1}$?

OR

- (ii) For a weak electrolyte, its molar conductance in dilute solutions increases sharply as its concentration in solution is decreased.

- (b) Equivalent conductance of a 0.0128 N solution of acetic acid is $1.4 \text{ mho cm}^2 \text{ eq}^{-1}$ and equivalent conductance at infinite dilution is $391 \text{ mho cm}^2 \text{ eq}^{-1}$. Calculate degree of dissociation and dissociation constant of acetic acid.

1. 3° amine is the strongest base in non-aqueous solvents.
2. $(\text{CH}_3)_3\text{N} > (\text{CH}_3)_2\text{NH} > \text{CH}_3\text{NH}_2 > \text{NH}_3$
3. In aqueous solution the basicity of amines depends on solvation effect and steric hindrance in addition to inductive effect.
4. N being less electronegative than O gives lone pair of electrons more easily than O atom.
5. In methylamine, the electron releasing effect of $-\text{CH}_3$ group increases the electron density on nitrogen

10. CH_3I

11. (c) : Solubility = $\frac{\kappa \times 1000}{\Lambda_m^\circ}$

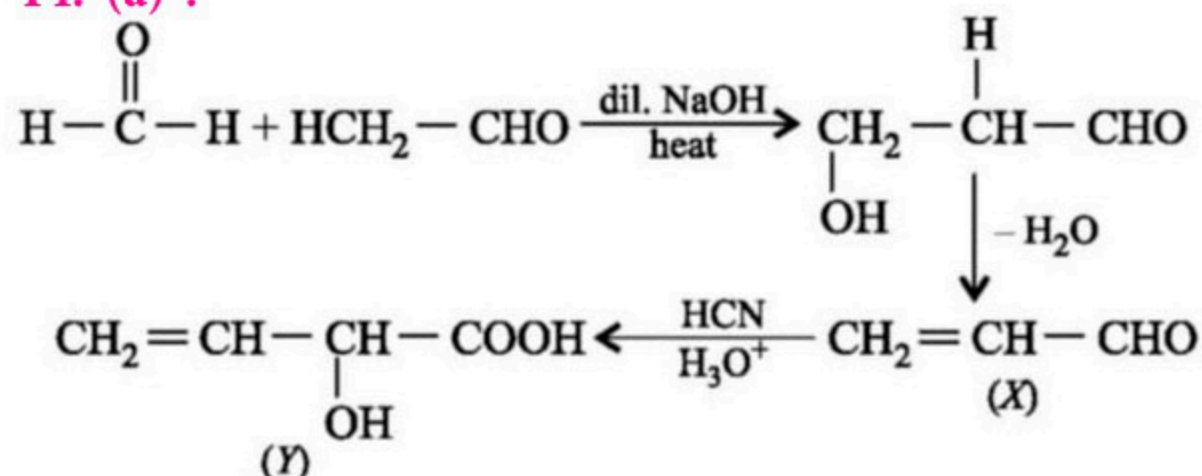
$$= \frac{1.821 \times 10^{-5} \times 1000}{130.26} = 13.97 \times 10^{-5} \text{ mol L}^{-1}$$

$$= 13.97 \times 10^{-5} \times 143.5 \quad (\text{AgCl} = 108 + 35.5 = 143.5)$$

$$= 2.004 \times 10^{-2} \text{ g L}^{-1}$$

13. (c)

14. (a) :



- 15. (c) :** $[\text{Co}(\text{py})_2(\text{H}_2\text{O})_2\text{Cl}_2]\text{Cl}$ and $[\text{Co}(\text{py})_2(\text{H}_2\text{O})\text{Cl}_3]\text{H}_2\text{O}$ show hydrate isomerism.

16. (d)

- 17. (c) :** Adenine forms hydrogen bonds with thymine whereas cytosine forms hydrogen bonds with guanine. Due to specific pairing of bases the two strands are complementary.

18. (a)

- 19. (c) :** The magnetic moment is determined by the number of unpaired electrons and is calculated by using the formula, $\mu = \sqrt{n(n+2)}$ where, n is number of unpaired electrons.

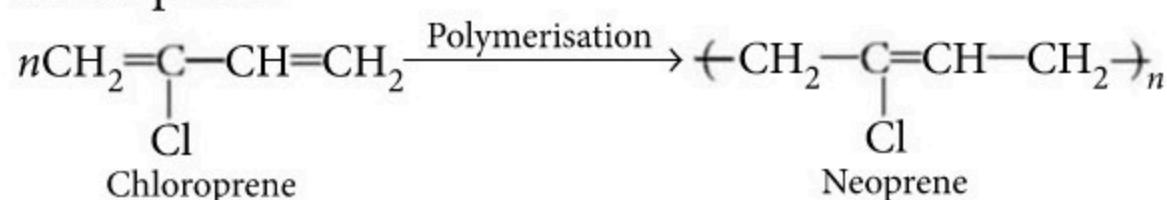
It increases with increase in number of unpaired electrons. Hence Mn^{2+} will have higher magnetic moment than Cr^{2+} .

20. (a)

- 21.** Polydienes are obtained from the polymerisation of unsaturated hydrocarbons with two double bonds or when a diene is added to a substituted alkene.

The polymers of this class are synthetic rubbers : Neoprene and Buna-S.

Neoprene is obtained by the polymerisation of chloroprene.

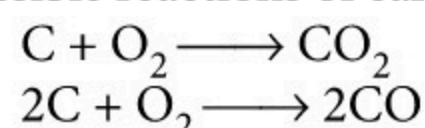


22. Effect of pressure : Adsorption is a dynamic equilibrium process and there is decrease in the pressure of the gas due to adsorption. Therefore, as expected adsorption increases with increase in pressure.

Effect of temperature : As adsorption is always exothermic, therefore, in accordance with Le-Chatelier's principle, the extent of adsorption would decrease with rise in temperature.

23. (a) Cryolite is added into molten alumina to lower its melting point and also increases its conductivity.

(b) At 710°C, CO is a better reducing agent. There are two possible reactions of carbon with oxygen.



Formation of CO₂ from C does not bring change in ΔS and thus in ΔG also, because volume of CO₂ produced is same as the volume of O₂ used. However formation of CO from C is accompanied by increase in gaseous volume and thus ΔS is also increased. Therefore, ΔG becomes increasingly negative with the rise of temperature.

OR

For a reaction/process to be favourable in a particular direction, the change in free energy (ΔG) in that direction should be negative. The more is the negative value of ΔG, the greater is the tendency for reaction to occur. ΔG is related to ΔH (enthalpy change) and ΔS (entropy change) through the relationship,

$$\Delta G = \Delta H - T\Delta S$$

For any reaction, ΔG depends upon temperature (T). Thus, ΔG decides about the temperature and the choice of any reducing agent in metallurgy.

24. Distinction between order and molecularity of a reaction :

Order of reaction	Molecularity of reaction
1. It is the sum of powers of the concentration of the reactants in the rate law expression.	1. It is the number of reacting species (atoms, ions or molecules) taking part in an elementary reaction which must collide simultaneously in order to bring about a chemical reaction.
2. It can be zero or even a fraction.	2. It is always a whole number.

25. $w_2 = 0.90 \text{ g}$, $w_1 = 87.90 \text{ g}$, $\Delta T_b = 0.25^\circ\text{C}$

$M_2 = 103 \text{ g mol}^{-1}$, $\Delta T_b = K_b m$

$$\Delta T_b = K_b \times \frac{w_2}{M_2} \times \frac{1000}{w_1 (\text{in g})}, K_b = \frac{\Delta T_b \times M_2 \times w_1 (\text{in g})}{w_2 \times 1000}$$

$$\Rightarrow K_b = \frac{0.25 \times 103 \times 87.90}{0.90 \times 1000} \Rightarrow K_b = \frac{2263.42}{900}$$

$$\Rightarrow K_b = 2.5149 = 2.515 \text{ K kg mol}^{-1}$$

OR

Given, $\pi = 7.2 \text{ atm}$, $R = 0.0821 \text{ L atm K}^{-1}$

$$T = 37^\circ\text{C} = 273 + 37 = 310 \text{ K}$$

$$\pi = \frac{n}{V} RT$$

$$\Rightarrow \pi = CRT$$

$$\left[\because C = \frac{n}{V} \right]$$

$$\Rightarrow 7.2 = C \times 0.0821 \times 310$$

$$\Rightarrow C = \frac{7.2}{0.0821 \times 310} \Rightarrow C = \frac{7.2}{25.451}$$

$$C = 0.283 \text{ mol L}^{-1}$$

26. Nucleotides are monomeric units of nucleic acids.

A nucleotide is made up of sugar + heterocyclic base + phosphate group.

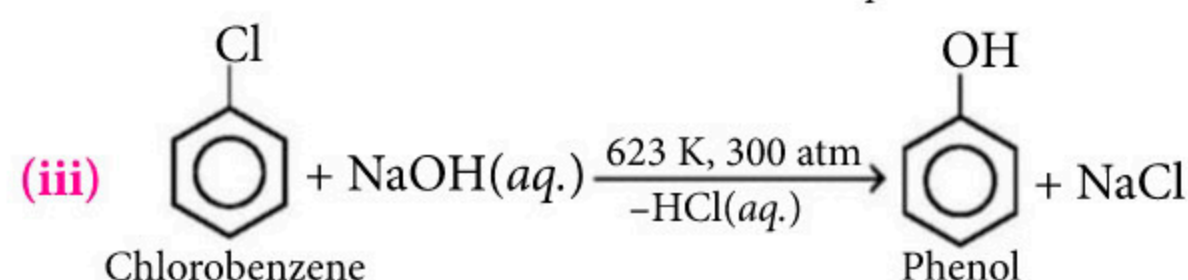
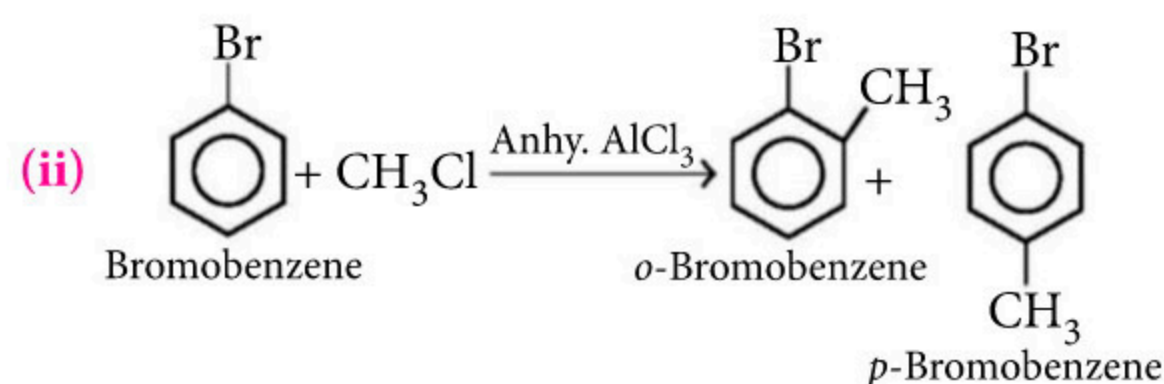
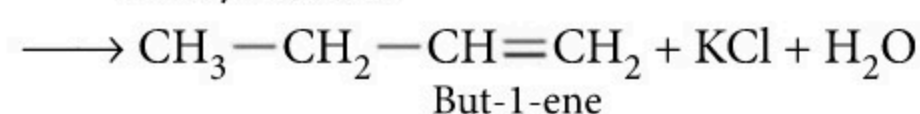
In case of the DNA nucleotide, the sugar is *D*-2-deoxyribose whereas in RNA nucleotide, it is *D*-ribose. They also differ with respect to one base, DNA contains thymine whereas RNA contains uracil.

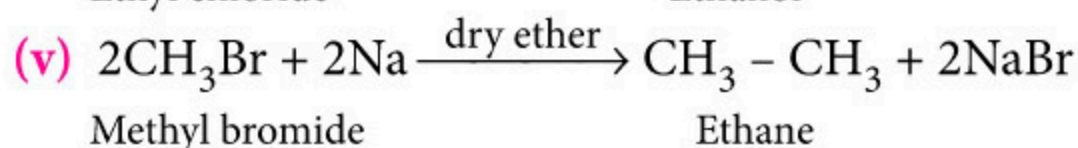
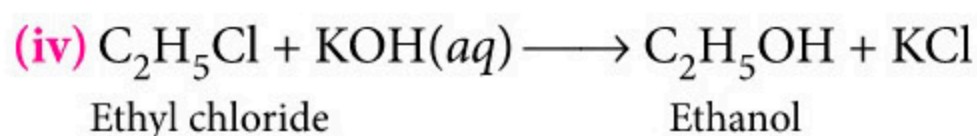
27. Antiseptics are chemical substances which inhibit the growth of microorganisms or kill them but are not harmful to the living tissues. For example, dettol and savlon.

Disinfectants are chemicals that inhibit the growth or kill pathogenic organisms (bacteria, virus, fungi) on non-living surfaces. For example, 1% solution of phenol and chlorine solution (0.2 ppm to 0.4 ppm).

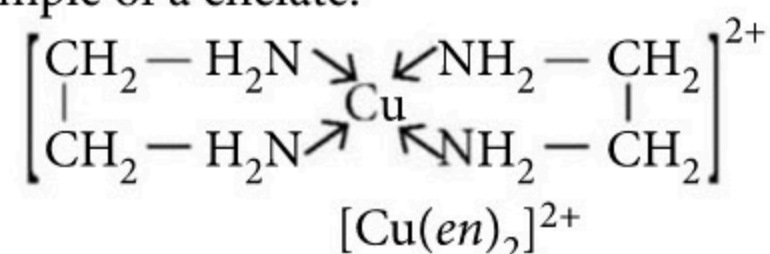
28. (i) $\text{CH}_3-\text{CH}_2-\text{CH}_2-\text{CH}_2\text{Cl} + \text{KOH}(\text{alc.})$

n-Butylchloride





29. (a) When a bidentate or polydentate ligand coordinates with the central metal ion, forming a five or six membered ring, the effect is called chelate effect. Due to chelation the stability of the complex increases. The complex formed by Cu^{2+} ion with ethylenediamine is an example of a chelate.



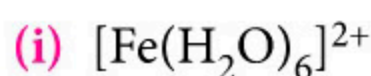
(b) As metal ion is fixed, the increasing field strengths (CFSE values) of the ligands from the spectrochemical series are in the order: $\text{H}_2\text{O} < \text{NH}_3 < \text{NO}_2^-$. Thus, the energies absorbed for excitation will be in the order:



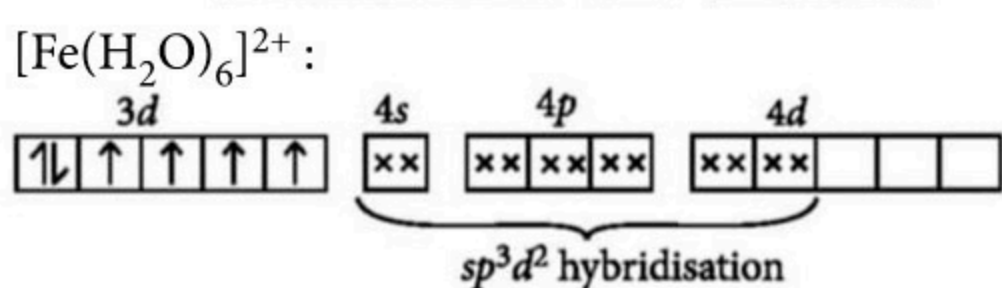
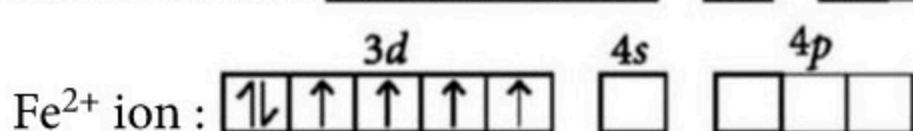
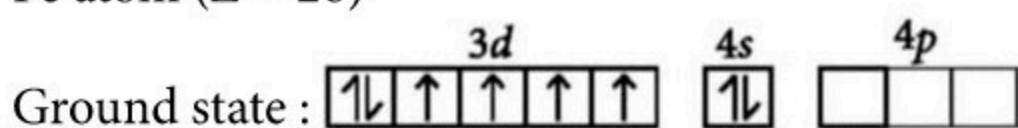
As $E = \frac{hc}{\lambda}$, the wavelengths absorbed will be in the opposite order, i.e.



OR

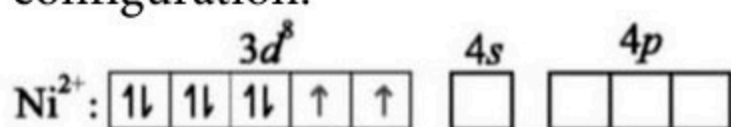


Fe atom ($Z = 26$)

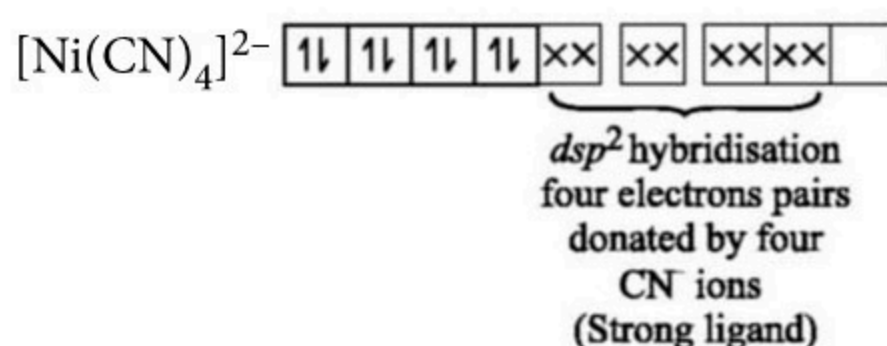


The Fe^{2+} ion has outer orbital octahedral geometry (high spin) with sp^3d^2 hybridisation. This complex is paramagnetic due to the presence of four unpaired electrons.

(ii) In $[\text{Ni}(\text{CN})_4]^{2-}$: Ni is present as Ni(II) with $3d^8$ configuration.



(In ground state)



The complex ion has square planar geometry and is diamagnetic in nature.

30. (i) Transition metals form a large number of complex compounds due to following reasons:

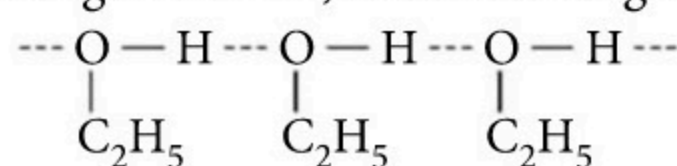
- Comparatively smaller size of metal ions.
- High ionic charges.
- Availability of d -orbitals for bond formation.

(ii) The lowest oxide of transition metal is basic because of some valence electrons are not involved in bonding thus act as a base due to the availability of free electrons. In the highest oxide of transition metal, electrons of metal are involved in the bonding. Therefore, these electrons are not available for donation. Hence they are acidic or amphoteric in nature.

e.g., MnO is basic whereas Mn_2O_7 is acidic.

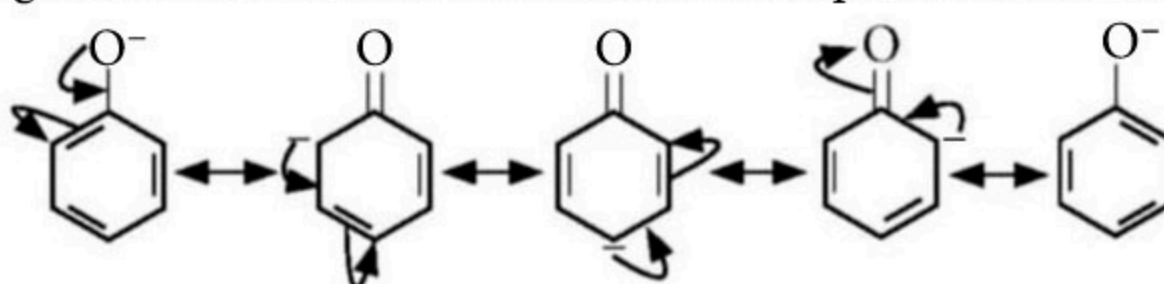
(iii) Much larger third ionisation energy of Mn (where change is d^5 to d^4) is mainly responsible for this. This also explains that +3 state of Mn is of little importance.

31. (i) Ethanol molecules get associated due to hydrogen bonding and hence, ethanol has higher boiling point.



But no such hydrogen bonding exists in methoxymethane.

(ii) The phenoxide ion formed after the release of proton gets stabilised due to resonance. Hence, phenol is acidic.



No such stabilisation occurs in case of ethoxide ($\text{C}_2\text{H}_5\text{O}^-$) ion.

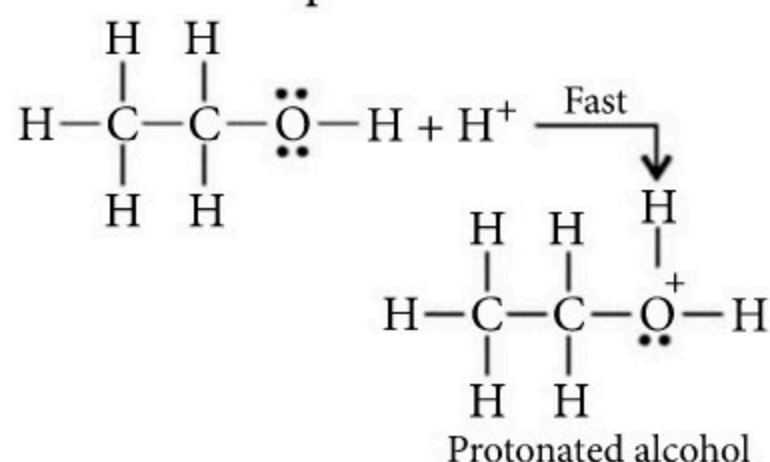
(iii) As we know that the electron withdrawing groups enhance the acidic character of phenols because they help in the stabilisation of phenoxide ion by dispersing negative charge. Nitro group is an electron withdrawing group whereas methoxy group destabilise the phenoxide ion by intensifying the negative charge as it is an electron donating group. Thus, *o*-nitrophenol is more acidic than *o*-methoxyphenol.

OR

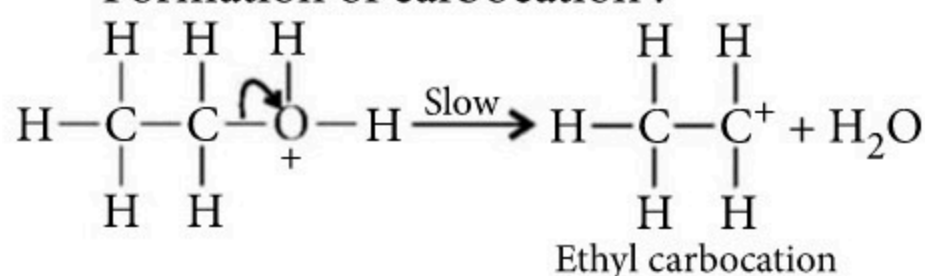
(i) Acid catalysed dehydration of alcohols at high temperature takes place with the formation of an alkene.

Mechanism : The dehydration of ethanol involves the following steps :

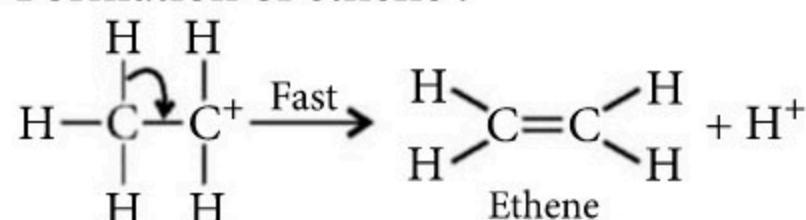
– Formation of protonated alcohol :



– Formation of carbocation :



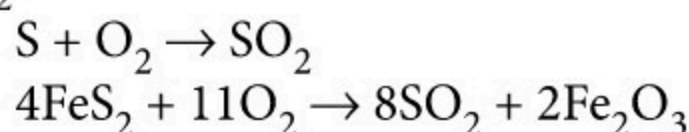
– Formation of ethene :



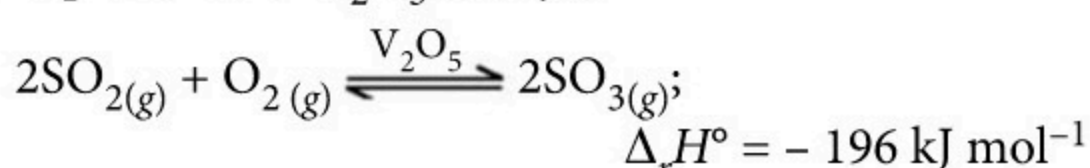
(ii) Phenols undergo electrophilic substitution reaction more easily than benzene due to strong activating effect of -OH group attached to benzene ring.

32. (a) Contact process : It involves three stages:

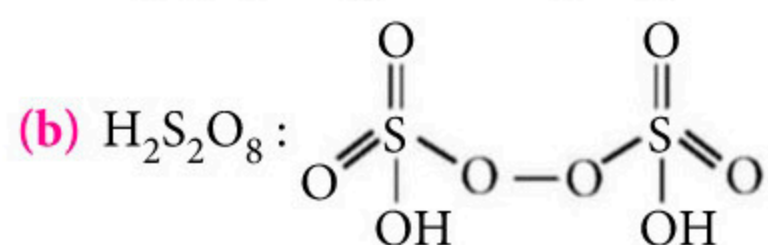
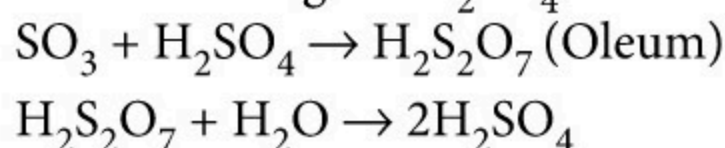
(i) Burning of sulphur or sulphide ore in air to generate SO_2 .



(ii) Conversion of SO_2 to SO_3 by reaction with oxygen in the presence of V_2O_5 catalyst.



(iii) The SO_3 gas from the catalytic converter is absorbed in conc. H_2SO_4 to form oleum ($\text{H}_2\text{S}_2\text{O}_7$). Dilution of oleum with water gives H_2SO_4 of desired concentration.



33. (i) Zn^{2+} ion has completely filled d -subshell and no $d-d$ transition is possible. So zinc salts are white. Configuration of Cu^{2+} is $[\text{Ar}]3d^9$. It has partly filled d -subshell and hence it is coloured due to $d-d$ transition.

(ii) Ce^{3+} ion having the configuration $[\text{Xe}]4f^1 5d^0 6s^0$ can easily lose electron to acquire the stable configuration $[\text{Xe}]4f^0 5d^0 6s^0$ and form Ce^{4+} ion. Hence, Ce^{3+} can be easily oxidised to Ce^{4+} ion.

(iii) Middle of the transition series contains greater number of unpaired electrons in $(n-1)d$ and ns orbitals.

34. Number of moles of ethanol = $\frac{60 \text{ g}}{46 \text{ g mol}^{-1}} = 1.304 \text{ mol}$

Number of moles of methanol = $\frac{40 \text{ g}}{32 \text{ g mol}^{-1}} = 1.250 \text{ mol}$

$$x_{\text{ethanol}} = \frac{1.304}{1.304 + 1.250} = \frac{1.304}{2.554} = 0.51$$

$$\therefore x_{\text{methanol}} = 1 - 0.51 = 0.49$$

$$\begin{array}{l} \text{Partial vapour pressure of ethanol} = p^\circ_{\text{ethanol}} \times x_{\text{ethanol}} \\ = 44.5 \times 0.51 = 22.69 \text{ mm Hg} \end{array}$$

$$\begin{array}{l} \text{Similarly, partial vapour pressure of methanol} = 88.7 \times 0.49 \\ = 43.46 \text{ mm Hg} \end{array}$$

$$\begin{array}{l} \text{Total vapour pressure of solution} = 22.69 + 43.46 \\ = 66.15 \text{ mm Hg} \end{array}$$

∴ According to Dalton's law of partial pressure,

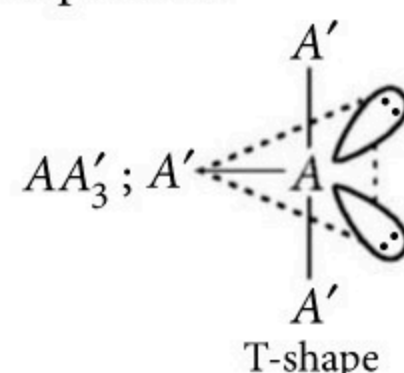
Vapour pressure of a component = Total vapour pressure × Mole fraction of that component in the vapour phase

∴ Mole fraction of methanol in vapour phase

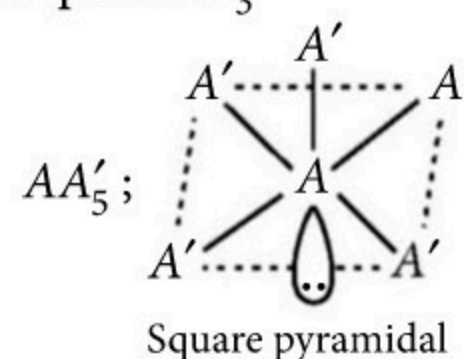
$$\begin{array}{l} = \frac{\text{Vapour pressure of methanol } (p_{\text{CH}_3\text{OH}})}{\text{Total vapour pressure}} = \frac{43.46}{66.15} \\ = 0.657 \end{array}$$

35. (a) AA'_3 ; $\begin{array}{c} \ddot{\text{A}}-\ddot{\text{A}}' \\ | \\ \text{Linear} \end{array}$

Example : ICl_3

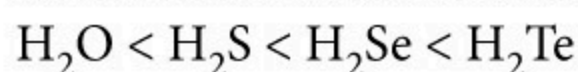


Example : BrF_3



Example : IF_5

(b) (i) Hydrides of oxygen family H_2E are weakly acidic in nature and acidic character increases as :



This can be explained on the basis of the size of the central atom. As the size of central atom increases, bond length ($E-H$) increases and bond dissociation enthalpy decreases which further increases the acidic character of hydrides.

(ii) Fluorine is the strongest oxidising agent therefore, it can form interhalogen compounds with other halogen in +5 and +7 oxidation states as it can provide energy for excitation of valence electrons.

OR

(a) (i) Structure of ICl_4^- :

No. of electrons in valence shell of the central I atom = 7

No. of electrons provided by four Cl atoms = $4 \times 1 = 4$

Charge on central atom = 1

\therefore Total no. of electrons around the central atom = $7 + 4 + 1 = 12$

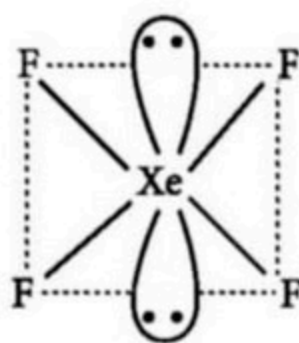
Total no. of electron pairs around the central atom = $\frac{12}{2} = 6$

But the no. of bond pairs = 4 (\because four I—Cl bonds)

\therefore No. of lone pairs = $6 - 4 = 2$

Therefore, according to VSEPR theory ICl_4^- should be square planar.

Now, a noble gas compound having 12 electrons in the valence shell of the central atom is XeF_4 , with square planar structure.



(ii) In BrO_3^- , since O is more electronegative than Br, therefore, negative charge stays on the O atom. Therefore, in BrO_3^- , there are two $Br=O$ bonds and one $Br-O^-$ bond. Now, according to VSEPR theory, double bonds do not contribute any electrons while single bonds contribute one electron towards the total number of electrons in the valence shell of the central atom. However, both double and single bonds contribute one bond pair. Thus, total number of electrons in the valence shell of the central Br atom = $7 + 2 \times 0 + 1 \times 1 = 8$

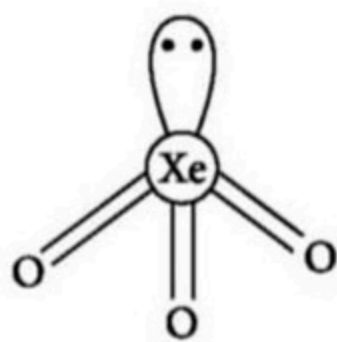
\therefore No. of electron pairs around Br atom = $\frac{8}{2} = 4$

But total number of bond pairs

= $2 \times 1 (Br=O) + 1 \times (Br-O^-) = 3$

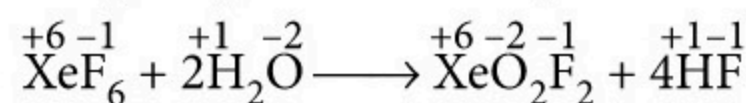
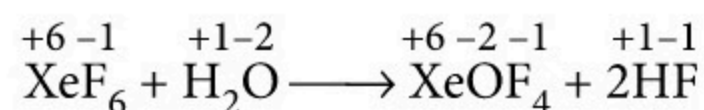
Thus, lone pairs = $4 - 3 = 1$

Thus, BrO_3^- has 3 bond pairs and one lone pair. Therefore, according to VSEPR theory, it should be pyramidal.

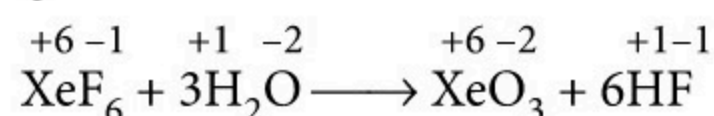


Now, a noble gas compound having 8 electrons in the valence shell of the central atom is XeO_3 .

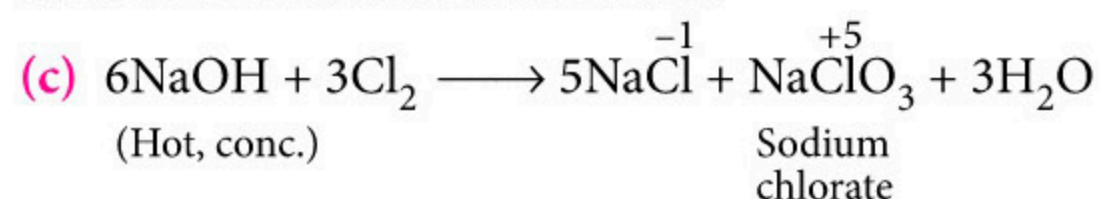
(b) Partial hydrolysis of XeF_6 gives $XeOF_4$ and XeO_2F_2 .



On the other hand, complete hydrolysis of XeF_6 gives XeO_3 .

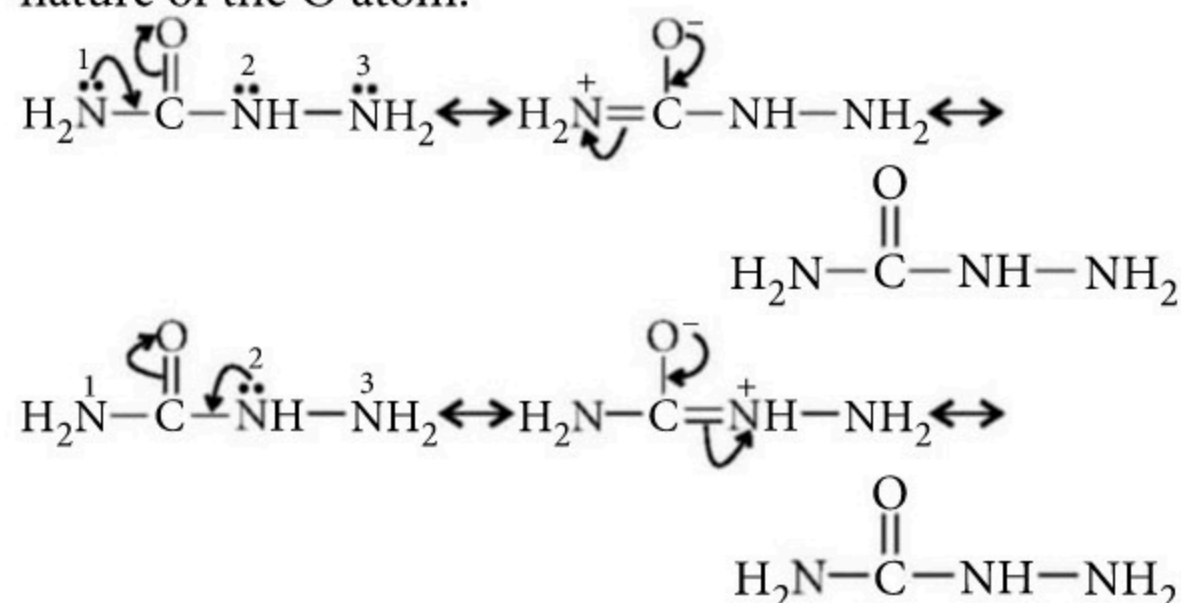


As the oxidation state of all elements in the reactants and products of hydrolysis remains the same. Therefore, these are not the redox reactions.



Yes, this reaction is a disproportionation reaction as chlorine from zero oxidation state changes to -1 and +5, oxidation states.

36. (a) (i) Semicarbazide has the following resonating structures, arising due to the electron withdrawing nature of the O atom.

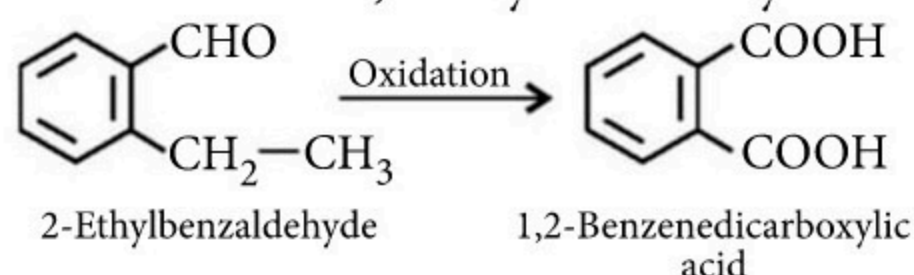


Lone pairs of N-1 and N-2 are involved in conjugation with $>C=O$ group while that of N-3 is not involved in resonance thus, it is involved in the formation of semicarbazone.

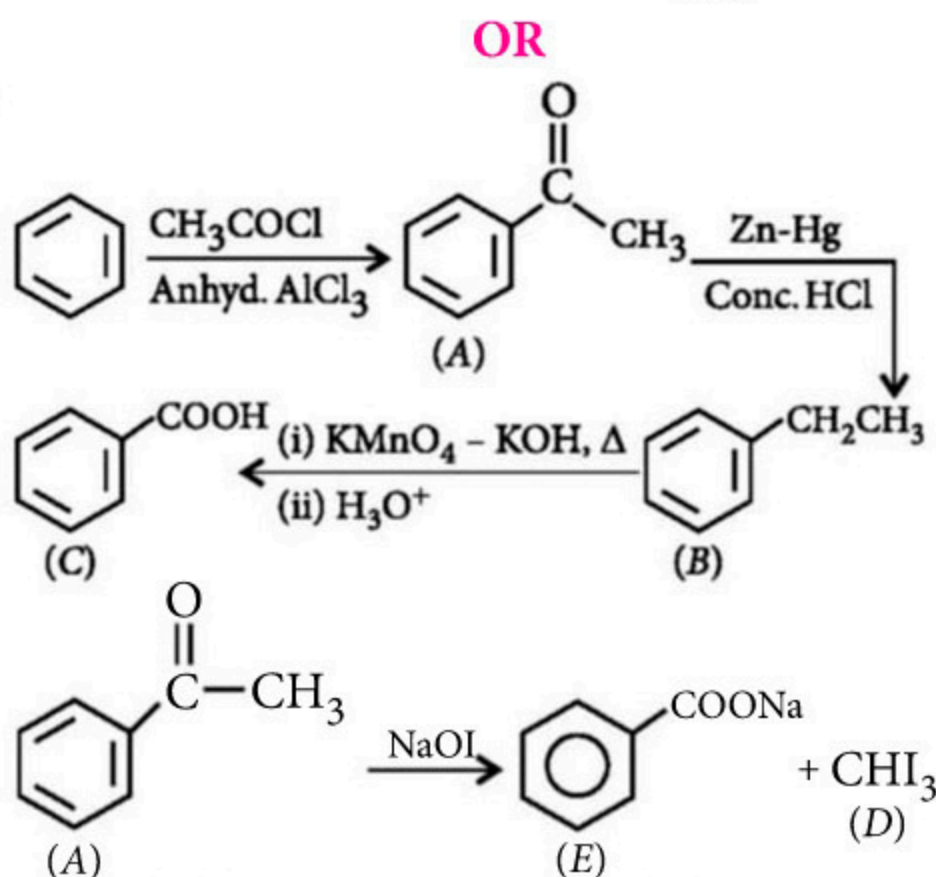
(ii) Formation of cyanohydrin involves the nucleophilic attack of cyanide ion (CN^-) at the carbonyl carbon. In cyclohexanone, reaction proceeds but in 2,4,6-trimethylcyclohexanone, the methyl groups cause steric hindrance and yield is poor.

(b) The compound forms 2,4-DNP derivative, it shows that it is a carbonyl compound. Further it reduces Tollens' reagent which shows that it contains aldehydic group. It undergoes Cannizzaro reaction indicating that aldehyde group is without any α -hydrogen. On vigorous oxidation, it gives 1,2-benzenedicarboxylic acid which shows that there are two carbon residues on

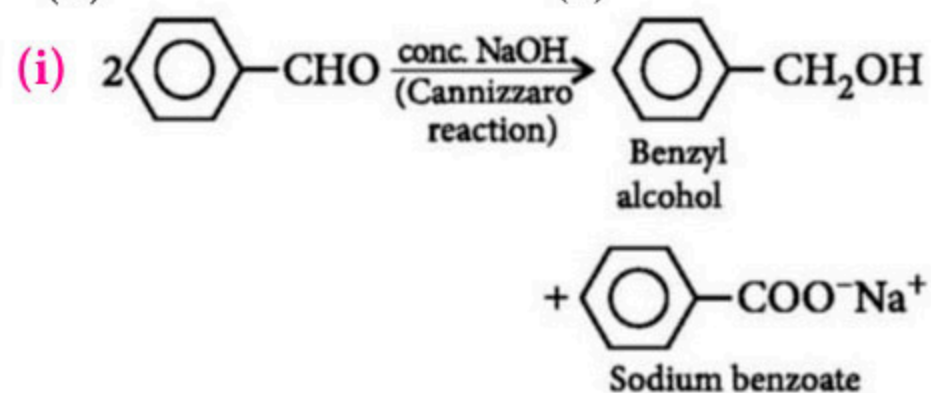
benzene ring. Since the molecular formula is $C_9H_{10}O$, it fits into the structure, 2-ethylbenzaldehyde.



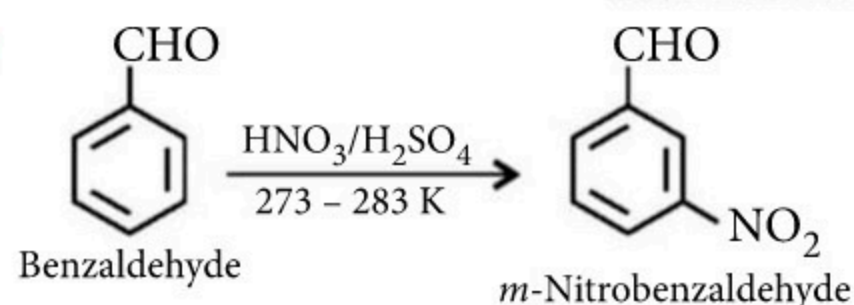
(a)



(b) (i)

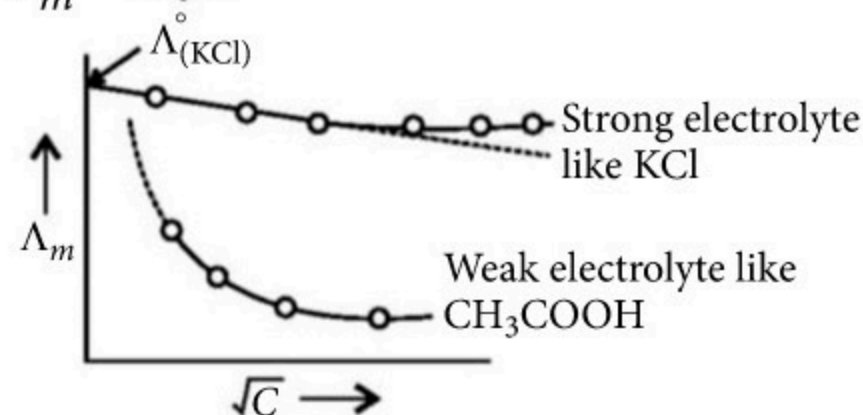


(ii)



37. (a) Variation of molar conductivity with concentration : For a strong electrolyte it is shown by Debye-Huckel Onsager equation as follows :

$$\Lambda_m = \Lambda_m^\circ - A\sqrt{C}$$



Here, Λ_m° = Molar conductivity at infinite dilution (Limiting molar conductivity)

Λ_m = Molar conductivity at V-dilution

A = Constant which depends upon nature of solvent and temperature.

C = Concentration

Plot of Λ_m against $C^{1/2}$ is a straight line with intercept equal to Λ_m° and slope equal to $-A$.

Thus, Λ_m^c decreases linearly with \sqrt{C} , when $C = 0$, $\Lambda_m^c = \Lambda_m^\circ$ and Λ_m° can be determined experimentally.

Molar conductivity increases with decrease in concentration. Because the total volume, V of solution containing one mole of electrolyte also increases. It has been found that decrease in κ on dilution of a solution is more than compensated by increase in its volume.

For weak electrolytes : There is a very large increase in conductance with dilution especially near infinite dilution as no. of ions increases. Λ_m^c increases as C decreases but does not reach a constant value even at infinite dilution. Hence, their Λ_m° cannot be determined experimentally.

For a strong electrolyte : There is only a small increase in conductance with dilution. This is because a strong electrolyte is completely dissociated in solution and so, the number of ions remain constant and on dilution, interionic attractions decreases as ions move far apart.

(b) Here, conductivity (κ) = $0.146 \times 10^{-3} \text{ S cm}^{-1}$, resistance (R) = 1500Ω

$$\text{Cell constant} = \frac{\text{Conductivity}}{\text{Conductance}}$$

$$= \text{Conductivity} \times \text{Resistance}$$

$$= \kappa \times R$$

$$\left[\because \text{conductance} = \frac{1}{\text{resistance}} \right]$$

$$= 0.146 \times 10^{-3} \times 1500 = 0.219 \text{ cm}^{-1}$$

OR

(a) (i) According to electrochemical theory during the formation of rust the impure iron surface behaves like a small electrochemical cell. In such cells pure iron acts as anode and impure surface acts as cathode. Moisture containing dissolved O_2 or CO_2 is the electrolytic solution. Hence, rusting is an electrochemical phenomenon.

(ii) On dilution, the degree of ionisation of the weak electrolyte increases. This increases the molar conductance of the solution sharply.

(b) Given : $\Lambda_{eq} = 1.4 \text{ mho cm}^2 \text{ eq}^{-1}$, $\Lambda_{eq}^\circ = 391 \text{ mho cm}^2 \text{ eq}^{-1}$, $\alpha = ?$, $K_a = ?$

$$\text{Using formula, } \alpha = \frac{\Lambda_{eq}}{\Lambda_{eq}^\circ} = \frac{1.4 \text{ mho cm}^2 \text{ eq}^{-1}}{391 \text{ mho cm}^2 \text{ eq}^{-1}} = 0.00358$$

$$\text{Again, } K_a = \frac{\alpha^2 C}{1 - \alpha} = \frac{(0.00358)^2 \times 0.0128}{1 - 0.00358} = \frac{0.00000016}{0.99642} = 1.6 \times 10^{-7}$$

MONTHLY TEST DRIVE



This specially designed column enables students to self analyse their extent of understanding of specified chapters. Give yourself four marks for correct answer and deduct one mark for wrong answer. Self check table given at the end will help you to check your readiness.

Surface Chemistry | General Principles and Processes of Isolation of Elements

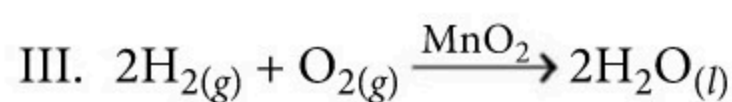
Total Marks : 120

Time Taken : 60 Min.

NEET

Only One Option Correct Type

- Soaps essentially form a colloidal solution in water and remove the greasy matter by
 - coagulation
 - emulsification
 - adsorption
 - absorption.
- Refractory materials used in furnaces
 - resist high temperature
 - become soft
 - are oxidised
 - melt on heating.
- Which of the following reactions gives a colloidal sol?
 - $\text{MgCO}_3 \rightarrow \text{MgO} + \text{CO}_2$
 - $2\text{Na} + 2\text{H}_2\text{O} \rightarrow 2\text{NaOH} + \text{H}_2$
 - $2\text{HNO}_3 + 3\text{H}_2\text{S} \rightarrow 3\text{S} + 4\text{H}_2\text{O} + 2\text{NO}$
 - $\text{Cu} + \text{CuCl}_2 \rightarrow \text{Cu}_2\text{Cl}_2$
- Purified bauxite is converted to metallic aluminium by
 - electrolytic reduction
 - hydrometallurgy
 - reduction with carbon
 - reduction with zinc.
- Hydrogen gas will not reduce
 - heated cupric oxide
 - heated ferric oxide
 - heated stannic oxide
 - heated aluminium oxide.
- $[\text{AgI}]\text{I}^-$ colloidal sol can be coagulated by the addition of a suitable cation. 1 mol of $[\text{AgI}]\text{I}^-$ requires mol of AgNO_3 , $\text{Pb}(\text{NO}_3)_2$ and $\text{Fe}(\text{NO}_3)_3$ as
 - 1, 1, 1
 - 1, 2, 3
 - $1, \frac{1}{2}, \frac{1}{3}$
 - 6, 3, 2
- Which of the following is an example of associated colloid?
 - Protein + Water
 - Soap + Water
 - Rubber + Benzene
 - $\text{As}_2\text{O}_3 + \text{Fe}(\text{OH})_3$
- Addition of high proportions of Mn makes steel useful in making rails because it
 - gives hardness to steel
 - help the formation of oxides of iron
 - can remove oxygen and sulphur
 - both (a) and (c).
- Tyndall effect is not found in
 - sugar solution
 - gold solution
 - suspension
 - emulsion.
- The following process is necessary to obtain purest form of copper metal:
 - Carbon reduction
 - Hydrogen reduction
 - Thermite process
 - Electrolytic process
- In the following reactions, catalysts used have been shown above the arrow. Which are not the suitable catalysts?
 - $2\text{H}_2\text{O}_{2(aq)} \xrightarrow{\text{I}^-(aq)} 2\text{H}_2\text{O}_{(l)} + \text{O}_{2(g)}$
 - $2\text{HCl}_{(g)} + 1/2\text{O}_{2(g)} \xrightarrow{\text{NO}_{(g)}} \text{H}_2\text{O}_{(l)} + \text{Cl}_{2(g)}$



- (a) I, II (b) II, III
(c) I, III (d) I, II, III

12. The term "fools gold" is used for a mineral which shines like gold. It is
(a) iron pyrites (b) bauxite
(c) cinnabar (d) cadmium sulphide.

Assertion & Reason Type

Directions : In the following questions, a statement of assertion is followed by a statement of reason. Mark the correct choice as :

- (a) If both assertion and reason are true and reason is the correct explanation of assertion.
(b) If both assertion and reason are true but reason is not the correct explanation of assertion.
(c) If assertion is true but reason is false.
(d) If both assertion and reason are false.

13. **Assertion :** Reduction of ZnO with carbon is done above 1100°C .

Reason : Above this temperature, ΔG° is negative thus, process is spontaneous.

14. **Assertion :** Colloidal AgI is prepared by adding AgNO_3 in slight excess to KI solution. When subjected to an electric field, the colloidal particles migrate to the anode.

Reason : Colloidal particles adsorb ions and thus, becomes electrically charged.

15. **Assertion :** Polling involves reduction of metal oxides to metals.

Reason : Green poles of wood produce hydrocarbon gases which act as reducing agents.

JEE MAIN / ADVANCED

Only One Option Correct Type

16. From the Ellingham graphs on carbon, which of the following statements is false?
(a) CO_2 is more stable than CO at less than 983 K .
(b) CO reduces Fe_2O_3 to Fe at less than 983 K .
(c) CO is less stable than CO_2 at more than 983 K .
(d) CO reduces Fe_2O_3 to Fe in the reduction zone of blast furnace.
17. Concentration of silver ore is based on its solubility in
(a) conc. HNO_3 (b) aqua regia
(c) dil. KCN (d) conc. KOH.
18. Which of the following form micelles in aqueous solution above certain concentration?

- (a) Dodecyl trimethyl ammonium chloride
(b) Glucose
(c) Urea
(d) Pyridinium chloride

19. For adsorption of a gas on a solid, the plot of $\log x/m$ vs $\log P$ is linear with a slope equal to (n being a whole number)
(a) k (b) $\log k$
(c) n (d) $1/n$

More than One Options Correct Type

20. Which of the following statements are correct?
(a) The protective power of a colloid may be measured by reciprocal of gold number.
(b) A gel is a colloidal system in which a solid is dispersed in a liquid.
(c) For positively charged sol, the coagulating power of coagulating ion decreases as : $\text{PO}_4^{3-} > \text{SO}_4^{2-} > \text{Cl}^-$.
(d) In colloids, the particle ions constituting the dispersed phase absorb only those ions preferentially which are opposite with the own lattice ions.
21. Carbon reduction method is commercially used for the extraction of
(a) haematite
(b) cassiterite
(c) argentite
(d) corundum.
22. Which of the following statements are not correct?
(a) A catalyst does not change ΔH of a reaction.
(b) The enzymes are highly specific in nature.
(c) Generally, very large quantities of enzyme catalysts are required to increase the rates of reaction.
(d) Oxidation of alcohol to acetic acid can be carried out by invertase enzyme.
23. Which of the following metals can be used for the extraction of Ti from TiO_2 ?
(a) Mg (b) Zn
(c) Na (d) Al

Numerical Value Type

24. 2.56 g of sulphur (colloidal sol) in 100 mL solution shows osmotic pressure of 2.463 atm at 27°C . How many sulphur atoms are associated in colloidal sol?

25. Iron sulphide on heating in air gives an oxide of sulphur which dissolves in water to give an acid. The basicity of the acid is
26. A sample of charcoal weighing 6.00 g was brought into contact with a gas contained in a vessel of 1 L capacity at 27°C. The pressure of the gas was found to fall from 700 to 400 mm. Calculate the volume of the gas (reduced to STP) that is adsorbed per gram of the adsorbent under the condition of the experiment (density of charcoal sample is 1.5 g cm^{-3})

Matrix Match Type

Answer the following questions (27 and 28) by appropriately matching the columns based on the information given in the passage :

Enzymes are biological catalysts produced by living cells which catalyse the biochemical reactions in living organisms. Their main characteristics are their specificity, efficiency and activity at physiological temperature of 37°C and pH of 7.4.

Column-I		Column-II	
(P)	Proteins \rightarrow Amino acid	I.	Zymase
(Q)	Glucose \rightarrow Ethyl alcohol + CO_2	II.	Lacto bacilli
(R)	Starch \rightarrow Maltose	III.	Pepsin
(S)	Milk \rightarrow Curd	IV.	Diastase

27. Which of the following has the correct combination considering column-I and column-II?
- (a) $P \rightarrow \text{I}$ (b) $Q \rightarrow \text{IV}$
(c) $R \rightarrow \text{III}$ (d) $S \rightarrow \text{II}$
28. Which of the following has the correct combination considering column-I and column-II?
- (a) $P \rightarrow \text{II}$ (b) $Q \rightarrow \text{III}$
(c) $R \rightarrow \text{IV}$ (d) $S \rightarrow \text{I}$

Answer the following questions (29 and 30) by appropriately matching the columns based on the information given in the passage :

The metallurgical procedure based on the roasting of an ore, followed by its reduction (usually with carbon), is known as pyrometallurgy. A key consideration in pyrometallurgy is the temperature at which reaction becomes spontaneous. As the term "pyro" suggests, often this temperature is quite high. Some of the characteristics of this process are :

Large quantities of waste material generated in concentrating low grade ores.

- High energy consumption to maintain high temperatures necessary for roasting and reduction of ores.
- Gaseous emission, such as SO_2 in roasting, that must be controlled.
- In hydrometallurgy, the materials handled are water and aqueous solutions at moderate temperature rather than dry materials at high temperature.

Column-I		Column-II	
(P)	Calcination	I.	$2\text{Cu}_2\text{S} + 3\text{O}_2 \rightarrow 2\text{Cu}_2\text{O} + 2\text{SO}_2$
(Q)	Roasting	II.	$\text{Fe}_2\text{O}_3 \cdot n\text{H}_2\text{O} \rightarrow \text{Fe}_2\text{O}_3 + n\text{H}_2\text{O}$
(R)	Flux	III.	$\text{Cr}_2\text{O}_3 + 2\text{Al} \rightarrow \text{Al}_2\text{O}_3 + 2\text{Cr}$
(S)	Thermite	IV.	$\text{SiO}_2 + \text{FeO} \rightarrow \text{FeSiO}_3$

29. Which of the following has the correct combination considering column-I and column-II?
- (a) $P \rightarrow \text{II}$ (b) $Q \rightarrow \text{IV}$
(c) $R \rightarrow \text{III}$ (d) $S \rightarrow \text{I}$
30. Which of the following has the correct combination considering column-I and column-II?
- (a) $P \rightarrow \text{III}$ (b) $Q \rightarrow \text{I}$
(c) $R \rightarrow \text{II}$ (d) $S \rightarrow \text{IV}$



Keys are published in this issue. Search now! ☺

SELF CHECK

No. of questions attempted
No. of questions correct
Marks scored in percentage

Check your score! If your score is

> 90%	EXCELLENT WORK !	You are well prepared to take the challenge of final exam.
90-75%	GOOD WORK !	You can score good in the final exam.
74-60%	SATISFACTORY !	You need to score more next time.
< 60%	NOT SATISFACTORY!	Revise thoroughly and strengthen your concepts.

GET SET GO for JEE

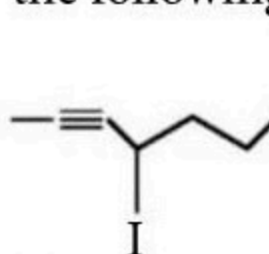


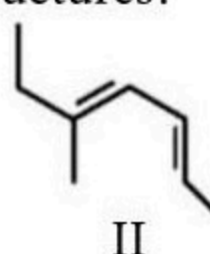
with exclusive and brain storming MCQs

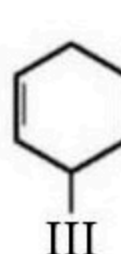
Practicing these MCQs help to strengthen your concepts and give you extra edge in your JEE preparation

Only One Option Correct Type

- Standard entropy of X_2 , Y_2 and XY_3 are 60, 40 and $50 \text{ J K}^{-1} \text{ mol}^{-1}$, respectively. For the reaction, $\frac{1}{2}X_2 + \frac{3}{2}Y_2 \rightarrow XY_3$, $\Delta H = -30 \text{ kJ}$, to be at equilibrium, the temperature will be
(a) 1250 K (b) 500 K (c) 750 K (d) 100 K
- Which of the following is correct for hydrogen?
(a) It is always collected at cathode.
(b) Its ionization energy is very low in comparison with alkali metals.
(c) It can form bonds in +1 as well as in -1 oxidation states.
(d) Its oxide is not stable.
- What is the total spin value in case of $_{26}\text{Fe}^{3+}$ ion
(a) +1 or -1 (b) +2 or -2
(c) +2.5 or -2.5 (d) +3 or -3
- What will happen if boron trifluoride is kept in moist air?
(a) It will strongly fume.
(b) It will partially hydrolyse.
(c) It will completely hydrolyse.
(d) None of these.
- In which of the following molecules number of lone pairs and bond pairs on central atom are not equal?
(a) H_2O (b) I_3^- (c) O_2F_2 (d) SCl_2
- Which of the following is incorrect statement for the following structures?


I


II


III

 (a) I, II and III have $\text{C}_n\text{H}_{2n-2}$ general formula.
 (b) I, II and III have same empirical formula.
 (c) I, II are identical and homologue of compound III.
 (d) I, II and III have same molecular formula.
- Phosphate pollution is caused by
(a) weathering of phosphate rock only
(b) agriculture fertilizers only
(c) phosphate rocks and sewage
(d) sewage and agricultural fertilizers.
- When propyne is treated with aqueous H_2SO_4 in presence of HgSO_4 the major product is
(a) propanal
(b) propyl hydrogen sulphate

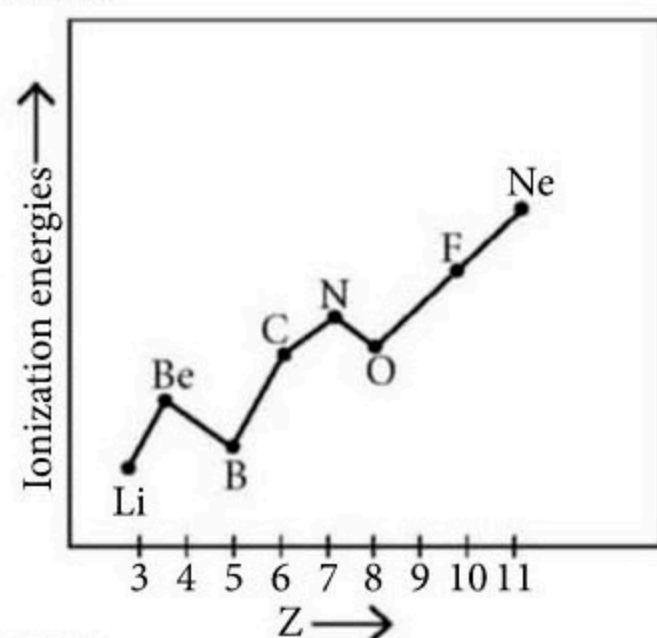
- (c) acetone (d) propanol.

9. Which is not correctly matched?

- (1) Basic strength of oxides $\text{Cs}_2\text{O} < \text{Rb}_2\text{O} < \text{K}_2\text{O} < \text{Na}_2\text{O} < \text{Li}_2\text{O}$
 (2) Stability of peroxides $\text{Na}_2\text{O}_2 < \text{K}_2\text{O}_2 < \text{Rb}_2\text{O}_2 < \text{Cs}_2\text{O}_2$
 (3) Stability of bicarbonates $\text{LiHCO}_3 < \text{NaHCO}_3 < \text{KHCO}_3 < \text{RbHCO}_3 < \text{CsHCO}_3$
 (4) Melting point $\text{NaF} < \text{NaCl} < \text{NaBr} < \text{NaI}$

- (a) 1 and 4 (b) 1 and 3 (c) 1 and 2 (d) 2 and 3

10. Following graph shows variation of ionization energies with atomic number in second period (Li – Ne). The value of ionization energies of Na(11) will be



- (a) above Ne
 (b) below Ne but above O.
 (c) below Li (d) between N and O.

More Than One Options Correct Type

11. A organic compound having molecular formula C_3H_4 , react with sodium metal to give a colourless and odourless gas. Select the correct statements about organic compound.

- (a) It gives Bromine water test.
 (b) It reacts with Bayer's reagent.
 (c) It reacts with Tollen's reagent.
 (d) It reacts with Ammonical cuprous chloride.

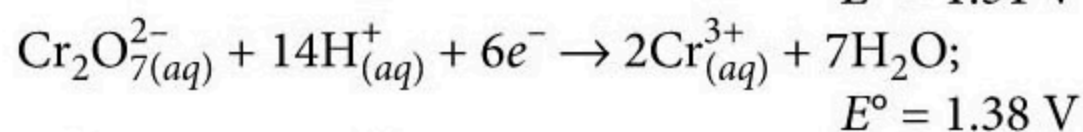
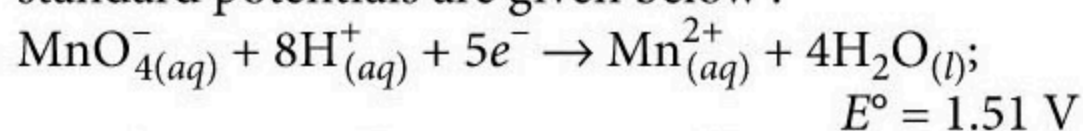
12. A vessel (A) contains 1 mole each of N_2 and O_2 , another vessel (B) contains 2 mole each of N_2 and O_2 . Both vessels are heated to same temperature till equilibrium is established in both cases. Then, incorrect statement is/are

- (a) K_C for $\text{N}_2 + \text{O}_2 \rightleftharpoons 2\text{NO}$ in A and B are in the ratio 1 : 2
 (b) K_P for $\text{N}_2 + \text{O}_2 \rightleftharpoons 2\text{NO}$ in A and B are in the ratio 1 : 2
 (c) K_C for $\text{N}_2 + \text{O}_2 \rightleftharpoons 2\text{NO}$ in A and B are equal
 (d) K_P for $\text{N}_2 + \text{O}_2 \rightleftharpoons 2\text{NO}$ in A and B are in the ratio 2 : 1.

13. If 100 g sample of clay (containing 19% H_2O , 40% silica, and inert impurities as rest) is partially dried so as to contain 10% H_2O , then which of the following a is/are correct?

- (a) The percentage of silica in partially dried clay is 44.4%.
 (b) The mass of partially dried clay is 90.0 g.
 (c) The percentage of inert impurity in partially dried clay is 45.6%.
 (d) None of these.

14. Standard electrode potential data are useful for understanding the suitability of an oxidant in a redox titration. Some half-cell reactions and their standard potentials are given below :



Identify the correct statements regarding the quantitative estimation of aqueous $\text{Fe}(\text{NO}_3)_2$.

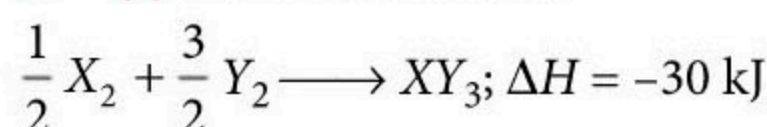
- (a) MnO_4^- can be used in aqueous HCl.
 (b) $\text{Cr}_2\text{O}_7^{2-}$ can be used in aqueous HCl.
 (c) MnO_4^- can be used in aqueous H_2SO_4 .
 (d) $\text{Cr}_2\text{O}_7^{2-}$ can be used in aqueous H_2SO_4 .

15. The rate of diffusion of two gases 'A' and 'B' are in the ratio 16 : 3. If the ratio of their masses present in the mixture is 2 : 3 then

- (a) the ratio of their molar masses is 16 : 1.
 (b) the ratio of their molar masses is 1 : 4.
 (c) the ratio of their moles present inside the container is 1 : 24.
 (d) the ratio of their moles present inside the container is 8 : 3.

SOLUTIONS

1. (c) : For the reaction,



Calculating ΔS for the above reaction, we get

$$\Delta S = S_{\text{product}} - S_{\text{reactant}}$$

$$\Delta S = 50 - \left[\frac{1}{2} \times 60 + \frac{3}{2} \times 40 \right] \text{ JK}^{-1}$$

$$= 50 - (30 + 60) \text{ JK}^{-1} = -40 \text{ JK}^{-1}$$

At equilibrium, $T\Delta S = \Delta H$

$$\therefore T \times (-40) = -30 \times 1000$$

$$\therefore T = \frac{-30 \times 1000}{-40} = 750 \text{ K}$$

[$\therefore \Delta G = 0$]

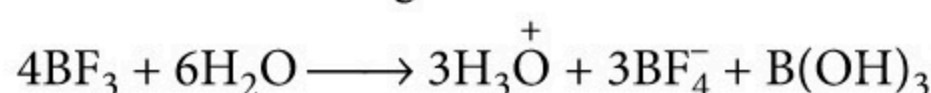
[$\therefore 1 \text{ kJ} = 1000 \text{ J}$]

2. (c)

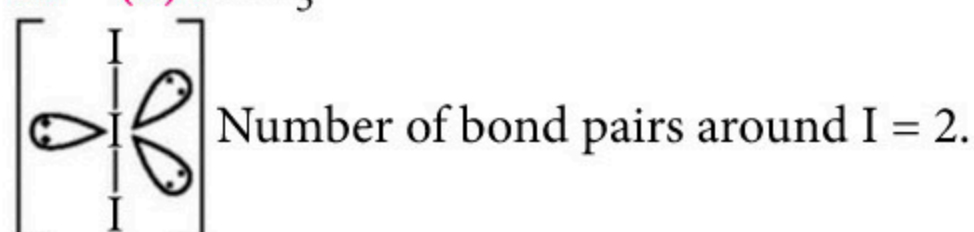
3. (c) : Total spin = no. of unpaired

$$e^- \times \left(\pm \frac{1}{2}\right) = 5 \times \left(\pm \frac{1}{2}\right) = \pm \frac{5}{2} \Rightarrow \pm 2.5$$

4. (a) : BF_3 fumes in moist air and react vigorously with water forming boric acid and tetrafluoroboric acid.



5. (b) : In I_3^-

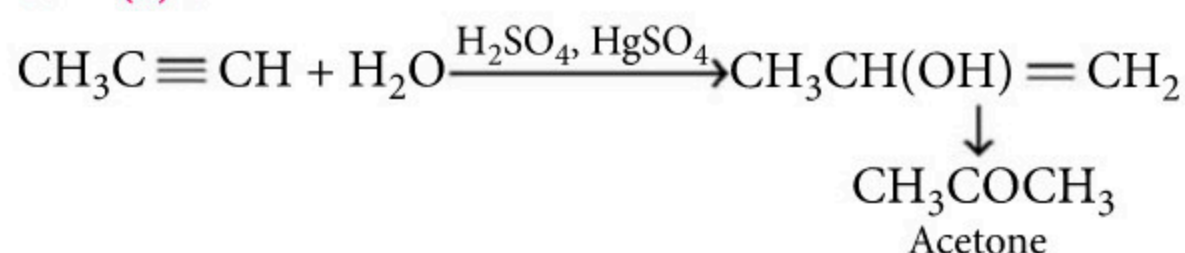


Number of lone pairs around I = 3.

6. (d)

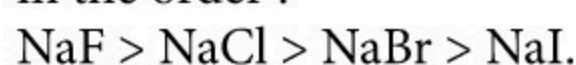
7. (d)

8. (c) :



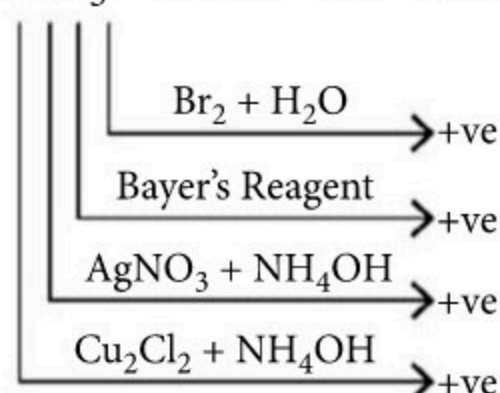
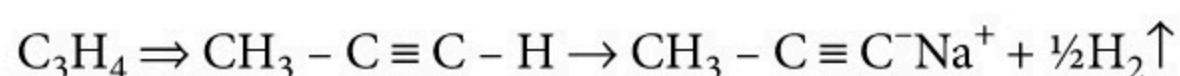
9. (a) : (1) Basic strength of the oxides increases in the order : $\text{Li}_2\text{O} < \text{Na}_2\text{O} < \text{K}_2\text{O} < \text{Rb}_2\text{O} < \text{Cs}_2\text{O}$. The increase in basic strength is due to the increase in metallic character down the group.

(4) The melting and boiling points of halides follow the trend : fluoride > chloride > bromide > iodide. As the size of anions increase, their tendency to get polarised increases and therefore, their covalent character increases and thus melting points decreases. So the melting points of the halides of sodium decreases in the order :



10. (c) : Na is 3rd period element and is bigger than Li. The distance between the nucleus and outer most electron is more as compared to Li. Thus, the outer most electron is loosely bound with nucleus and removal of electron is easier.

11. (a, b, c, d) :



12. (a, b, d)

13. (a, b, c) :

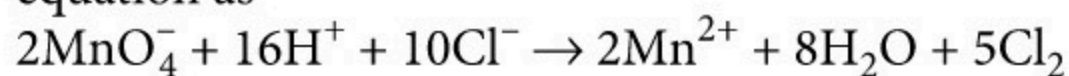
	Silica	H ₂ O	Impurities
% in original clay ⇒	40	19	100 - (40 + 19) = 41
% after partial drying ⇒ a		10	100 - (a + 10) = 90 - a

On heating, only water evaporates from clay, whereas silica and impurities are left as it is. Therefore, % ratio of silica and impurities remains unchanged, i.e.,

$$\frac{40}{a} = \frac{41}{90 - a} \Rightarrow a = 44.4 \%$$

% of inert impurities after partial drying
= (90 - a) = (90 - 44.4) = 45.6 %

14. (b, c, d) : MnO_4^- will oxidise Cl^- ion according to equation as



The cell corresponding to the above equation is



$$E_{\text{cell}}^\circ = (1.51 - 1.40) \text{ V} = 0.11 \text{ V}$$

Since E_{cell}° is positive so ΔG° ($\Delta G^\circ = -nFE^\circ$) must be negative and so this cell is feasible.

MnO_4^- will oxidise both Fe^{2+} ions and Cl^- ions simultaneously and so it cannot be used for the quantitative estimation of aq. $\text{Fe}(\text{NO}_3)_2$.

15. (b, d) : Given, $\frac{r_A}{r_B} = \frac{16}{3}$; $\frac{w_A}{w_B} = \frac{2}{3}$

$$\frac{r_A}{r_B} = \frac{n_A}{n_B} \sqrt{\frac{M_B}{M_A}}$$

$$\frac{16}{3} = \frac{w_A}{M_A} \frac{M_B}{w_B} \sqrt{\frac{M_B}{M_A}}; \frac{16}{3} = \frac{2}{3} \left(\frac{M_B}{M_A}\right)^{3/2}$$

$$\Rightarrow \left(\frac{M_B}{M_A}\right)^{3/2} = 8 \Rightarrow \frac{M_B}{M_A} = 4$$

∴ Mole ratio = 8 : 3



COMIC CAPSULE

Are you made
of copper
and tellurium?
Because you're CuTe.



CLASS-XI

for **NEET/JEE**

2020

BRUSH UP

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**Unit
7**

Organic Chemistry-Some Basic Principles and Techniques

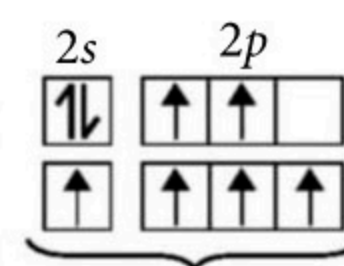
Organic Chemistry-Some Basic Principles and Techniques

- Organic chemistry deals with the study of hydrocarbons (compounds of carbon and hydrogen elements) and other compounds regarded as derivatives of hydrocarbons. Some organic compounds may also contain nitrogen, oxygen, sulphur, phosphorus, halogens, etc.
- Reasons for existence of large number of organic compounds :**
 - Tetravalency :** Atomic number of carbon atom is 6 and it has four valence electrons so C-atom is tetravalent.
- Types of hybridisation of C-atom :**

In ground state
(here, covalency of carbon is 2)

First excited state

(here, covalency of carbon is 4)



Available for bond formation

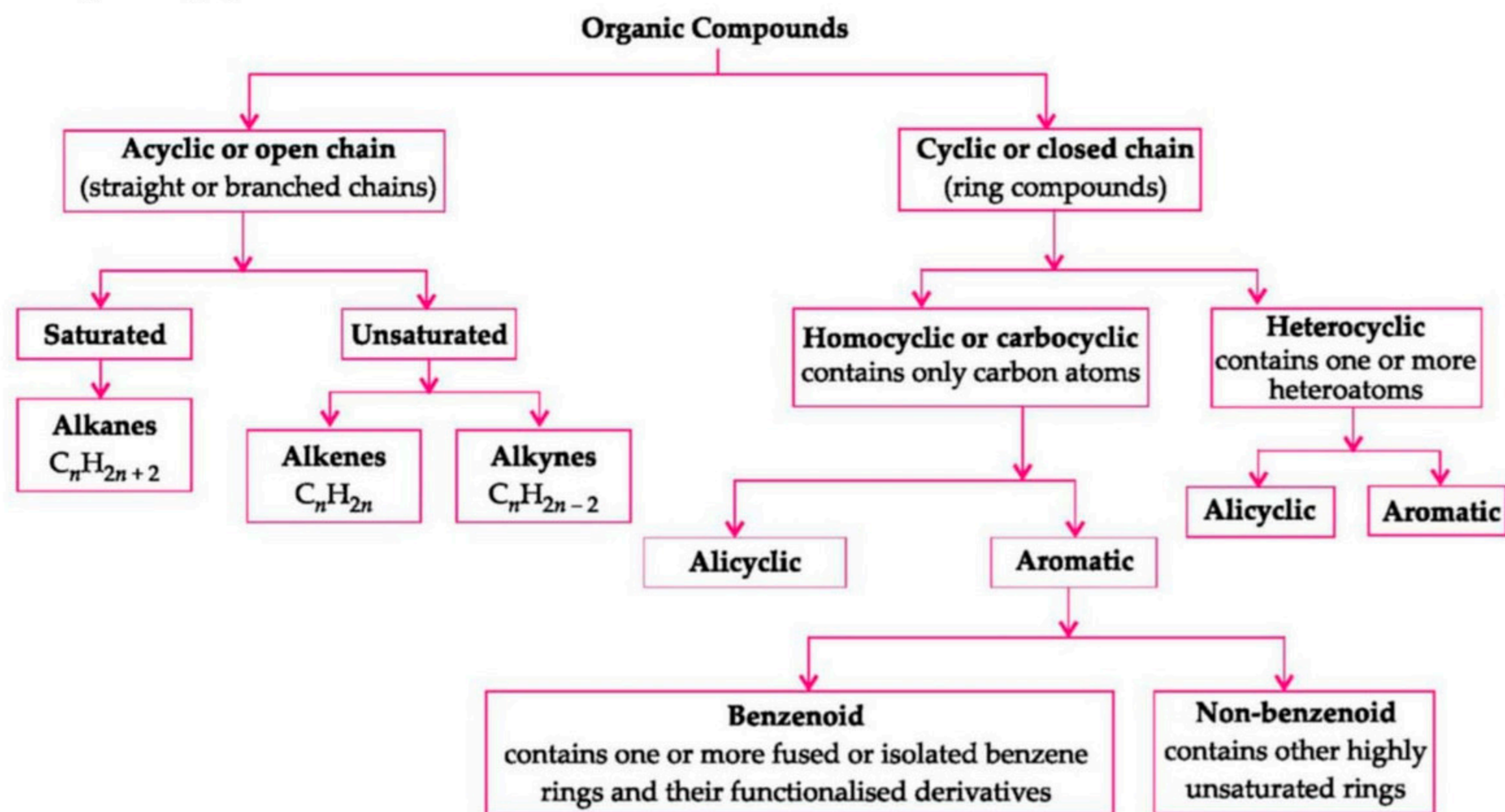
- Catenation :** The property of atoms of an element to link with one another forming chains of identical atoms is called catenation. Carbon exhibits catenation to the maximum extent.
- Formation of multiple bonds :** Because of its small size carbon atom is capable of forming multiple bonds with other atoms and this gives a variety of compounds.

Hybridisation	Participating orbitals	Number of equivalent orbitals formed	Unhybridised orbitals	Structuret	Bond angle	Examples
sp^3	one s and three p	4	0	Tetrahedral	$109^{\circ}28'$	Ethane, methane
sp^2	one s and two p	3	1	Trigonal planar	120°	Ethene, propene
sp	one s and one p	2	2	Linear	180°	Ethyne, propyne

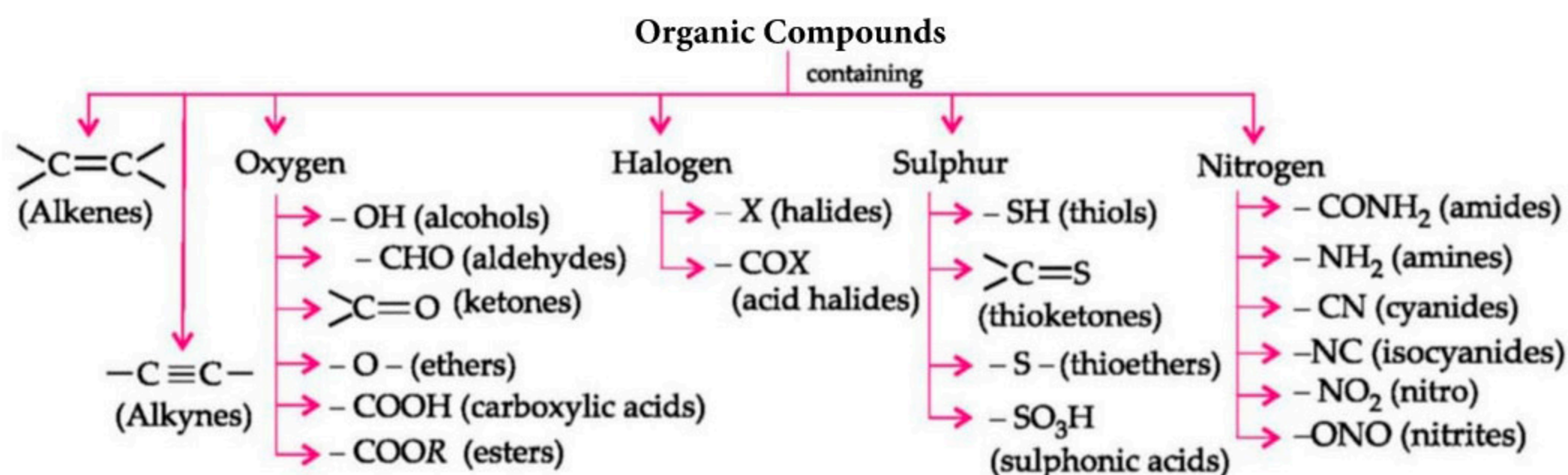
CLASSIFICATION OF ORGANIC COMPOUNDS

Organic compounds are broadly classified into following categories:

- Depending upon the nature of their carbon skeleton:



- Based on functional groups :



- Homologous series :** A series of organic compounds where preceding or succeeding members differ by one —CH_2 group is called homologous series and the members are called homologues.
- Characteristics of a homologous series :**
 - Difference in the molecular masses of two successive homologues is 14 ($\text{CH}_2 = 12 + 2 \times 1 = 14$).
 - They are represented by a general molecular formula :

Alkanes	$\text{C}_n\text{H}_{2n+2}$
Alkenes	C_nH_{2n}
Alkynes	$\text{C}_n\text{H}_{2n-2}$

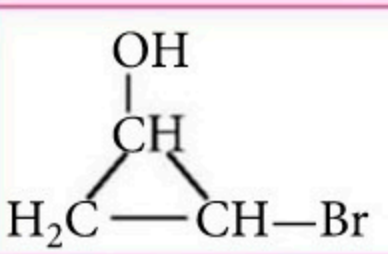
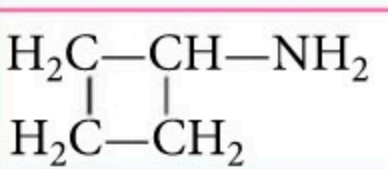
- Members of the homologous series can be prepared by the general methods of preparation developed for that series.
- They show regular gradation in physical properties.
- They have almost similar chemical properties.

NOMENCLATURE OF ORGANIC COMPOUNDS

IUPAC name of an organic compound has the following arrangement.

Secondary prefix + Primary prefix + Word root + Primary suffix + Secondary suffix

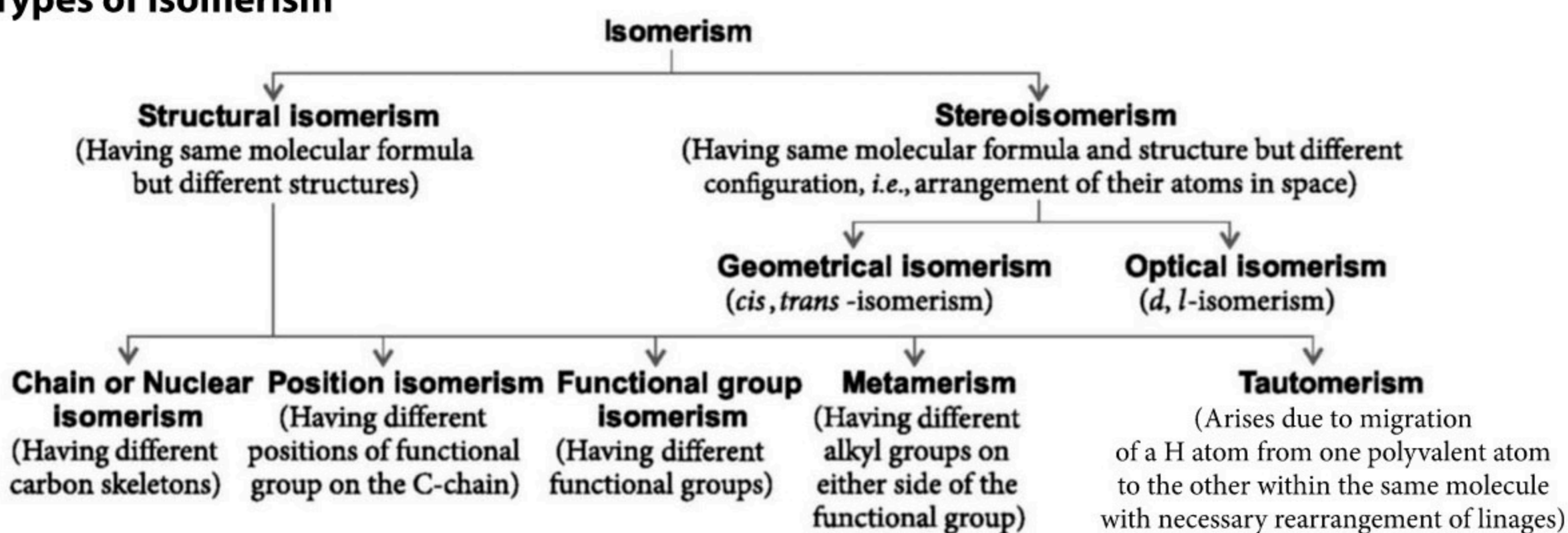
For example,

Organic compound	Secondary prefix	Primary prefix	Word root	Primary suffix	Secondary suffix	IUPAC name
	Bromo	Cyclo	Prop	ane	ol	Bromocyclopropanol
CH ₃ CH ₂ CH ₂ OCH ₃	Methoxy	–	Prop	ane	–	Methoxypropane
	–	Cyclo	But	ane	amine	Cyclobutanamine

ISOMERISM

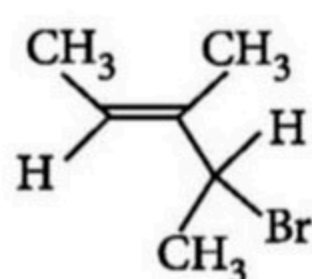
It is the property by virtue of which two or more compounds have the same molecular formula but different physical or chemical properties.

Types of Isomerism



PEEP INTO PREVIOUS YEARS

1. What is the IUPAC name of the following compound?



- (a) 4-Bromo-3-methylpent-2-ene
(b) 2-Bromo-3-methylpent-3-ene
(c) 3-Bromo-3-methyl-1,2-dimethylprop-1-ene
(d) 3-Bromo-1,2-dimethylbut-1-ene

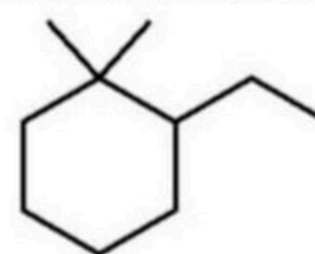
(JEE Main 2019)

2. Which of the following molecules represents the order of hybridisation sp^2 , sp^2 , sp , sp from left to right atoms?

- (a) $\text{HC} \equiv \text{C} - \text{C} \equiv \text{CH}$
(b) $\text{CH}_2 = \text{CH} - \text{C} \equiv \text{CH}$
(c) $\text{CH}_2 = \text{CH} - \text{CH} = \text{CH}_2$
(d) $\text{CH}_3 - \text{CH} = \text{CH} - \text{CH}_3$

(NEET 2018)

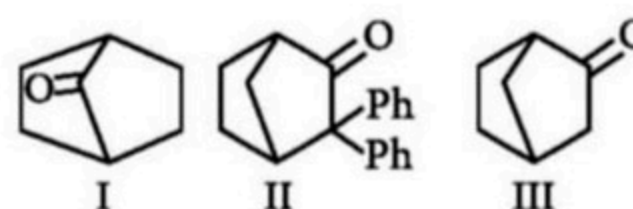
3. The IUPAC name of the following compound is



- (a) 1-ethyl-2, 2-dimethylcyclohexane
(b) 2, 2-dimethyl-1-ethylcyclohexane
(c) 1, 1-dimethyl-2-ethylcyclohexane
(d) 2-ethyl-1, 1-dimethylcyclohexane.

(JEE Main 2017)

4. Which among the given molecules can exhibit tautomerism?



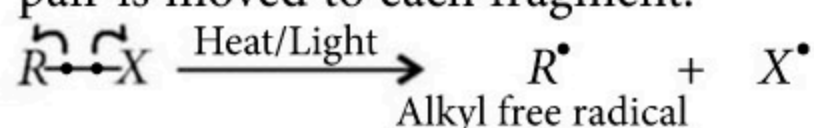
- (a) III only
(b) Both I and III
(c) Both I and II
(d) Both II and III

(NEET-II 2016)

FUNDAMENTAL CONCEPTS IN ORGANIC REACTION MECHANISM

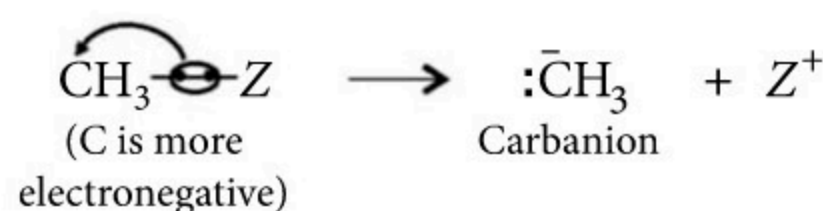
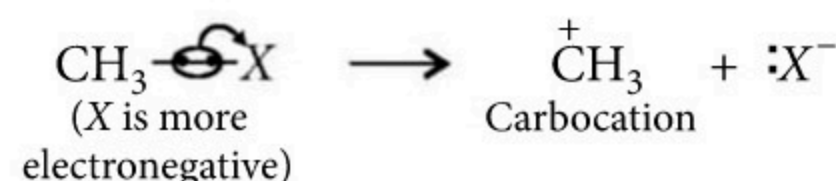
Fission of a covalent bond :

- Homolytic fission (symmetrical) :** Free radicals are formed by homolytic cleavage of covalent bond in which one of the electrons of the shared pair is moved to each fragment.



- Heterolytic fission (unsymmetrical) :** Positive and negative ions are formed by heterolytic

cleavage of covalent bond in which both the electrons of the bonding pair are moved to one of the fragments (*i.e.*, towards more electronegative atom).



Reaction Intermediates

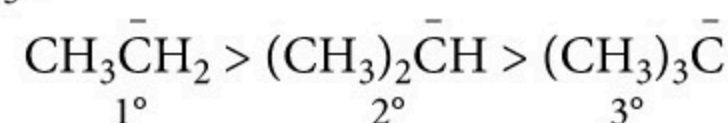
Intermediates	Definition	Hybridisation of carbon and shape	Stability order
Carbocation	Carbon species carrying +ve charge on carbon.	sp^2 hybridised carbon and planar structure.	$3^\circ > 2^\circ > 1^\circ$
Carbanion	Carbon species carrying -ve charge on carbon.	sp^3 hybridised carbon and pyramidal shape.	$1^\circ > 2^\circ > 3^\circ$
Free radical	Atom or group of atoms having odd or unpaired electron.	sp^2 hybridised carbon and planar structure.	$3^\circ > 2^\circ > 1^\circ$

Relative stabilities of carbocation :

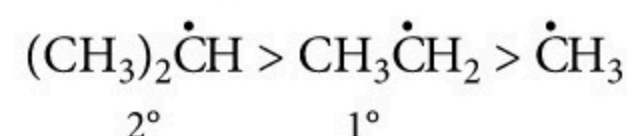
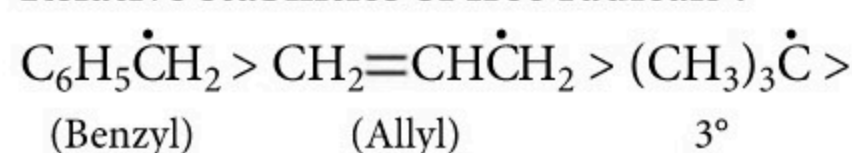
- $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2^+ > \text{CH}_3\text{CH}_2\text{CH}_2^+ > \text{CH}_3\text{CH}_2^+ > \text{CH}_3^+$
- $\text{Ph}_3\text{C}^+ > \text{Ph}_2\text{CH}^+ > (\text{CH}_3)_3\text{C}^+ > \text{PhCH}_2^+ > (\text{CH}_3)_2\text{CH}^+ > \text{C}_6\text{H}_5^+ > \text{CH}_3^+ > \text{HC}\equiv\text{C}^+$

Relative stabilities of carbanions :

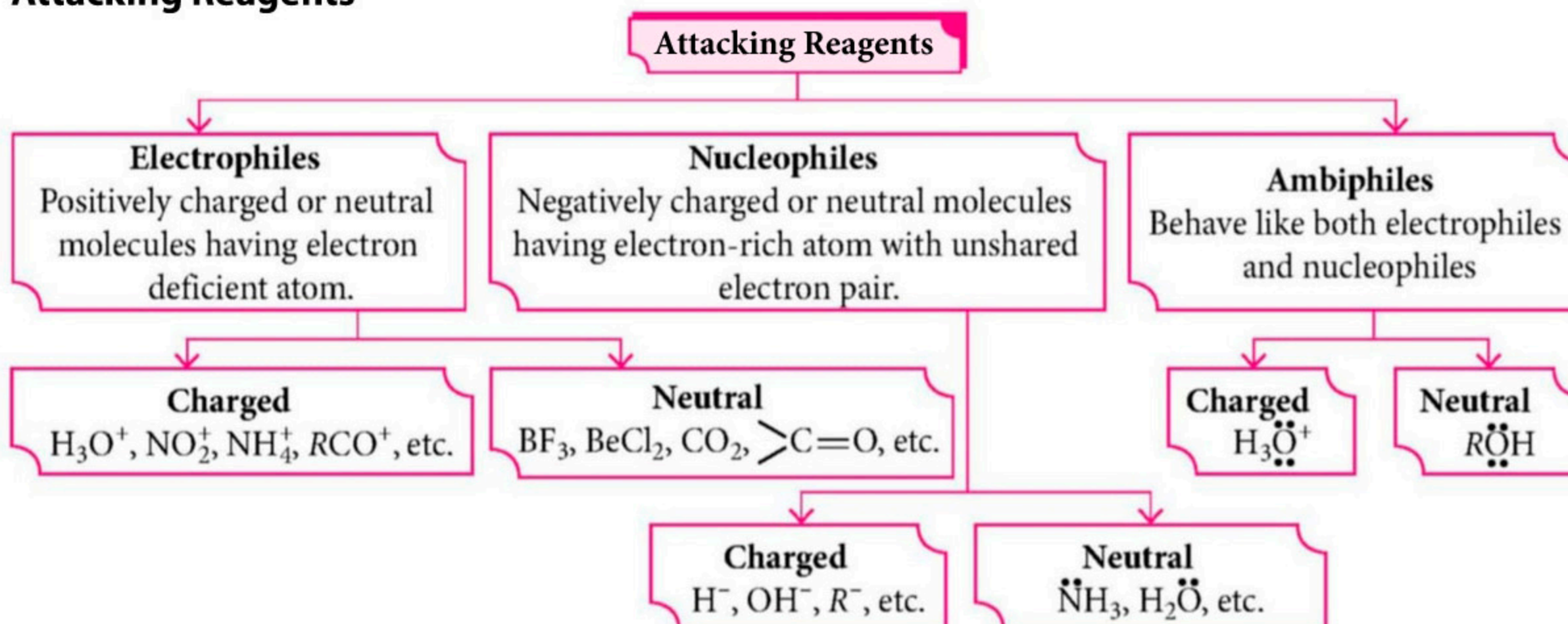
- $\text{HC}\equiv\text{C}^- > (\text{C}_6\text{H}_5)_3\text{C}^- > (\text{C}_6\text{H}_5)_2\text{CH}^- > \text{C}_6\text{H}_5\text{CH}_2^- > \text{CH}_2=\text{CH}-\text{CH}_2^- > \text{C}_6\text{H}_5^-$



Relative stabilities of free radicals :



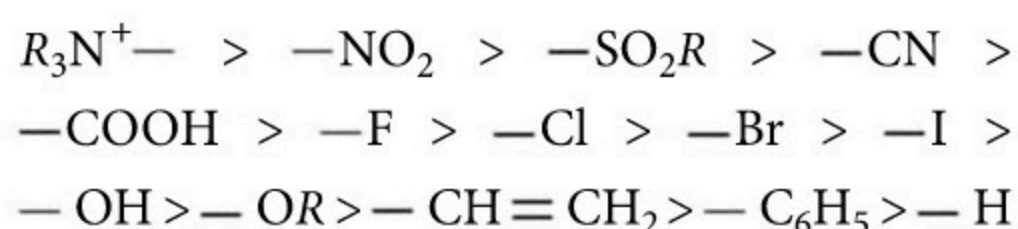
Attacking Reagents



Electron Displacement Effects in Covalent Bonds

- **Inductive effect (I effect)** : Displacement of σ electrons along a saturated carbon chain when an electron donating (+I effect) or electron withdrawing (−I effect) group is attached at the end of the carbon chain.

– **Decreasing order of −I effect :**



– **Decreasing order of +I effect :** $(CH_3)_3C - > (CH_3)_2CH - > CH_3CH_2 - > CH_3 - > D > H$

- **Electromeric effect (E effect)** : It involves complete transfer of π electrons of a multiple bond towards one of the bonded atoms in the presence of an attacking reagent.

– **+E effect** : When electron transfer takes place towards the atom to which the attacking reagent gets attached.

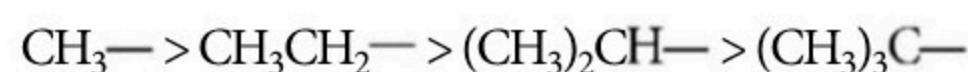
– **−E effect** : When electron transfer takes place away from the atom to which the attacking reagent gets attached.

- **Resonance or mesomeric effect** : It is defined as the polarity produced in the molecule by the interaction of two π bonds or between a π bond and a lone pair of electrons present on adjacent atom.

– **+R or +M effect** : $-Cl, -Br, -I, -NH_2, -NHR, -NR_2, -NHCOR, -OH, -OR, -SR, -SH$, etc.

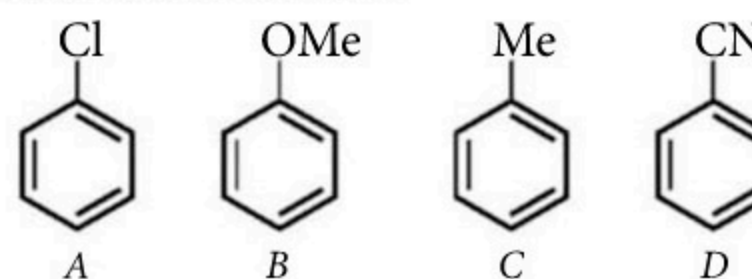
– **−R or −M effect** : $-NO_2, -CN, >C=O, -CHO, -COOH, -COOR, CH_2=CH-CHO$, etc.

- **Hyperconjugation** : It involves delocalisation of σ electrons of C—H bond of an alkyl group directly attached to an atom of unsaturated system or to an atom with an unshared p -orbital. For an alkyl group attached to an unsaturated system it decreases with decrease in number of α -hydrogens :



PEEP INTO PREVIOUS YEARS

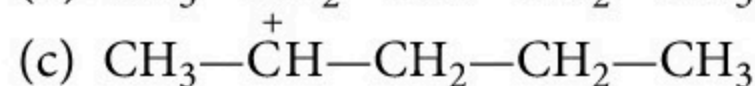
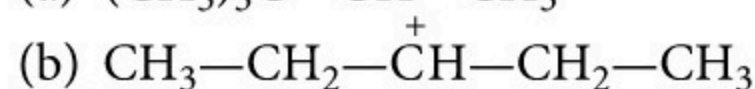
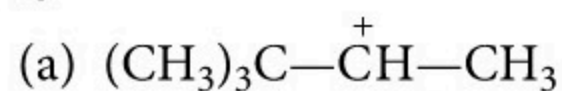
5. The increasing order of reactivity of the following compounds towards aromatic electrophilic substitution reaction is



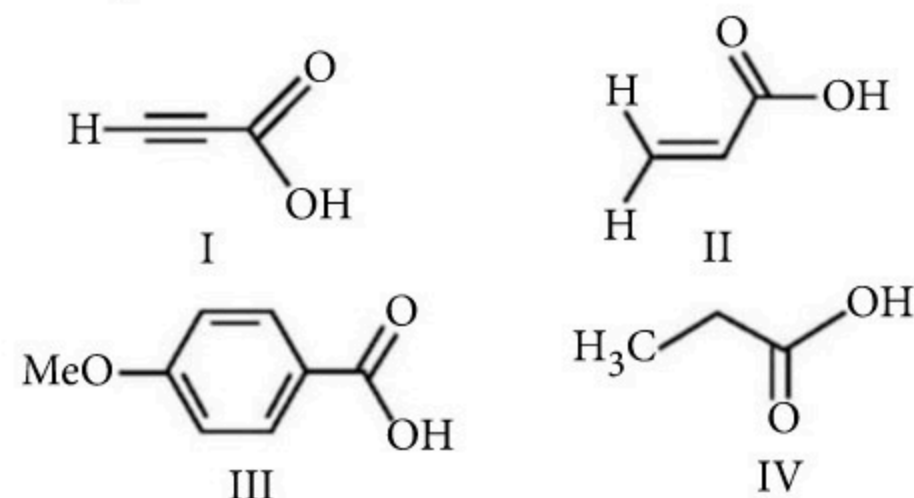
- (a) $D < B < A < C$ (b) $B < C < A < D$
(c) $A < B < C < D$ (d) $D < A < C < B$

(JEE Main 2019)

6. The most stable carbocation, among the following is



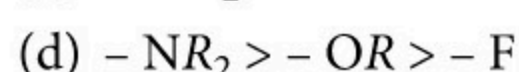
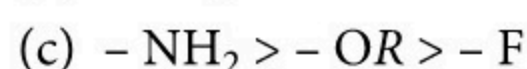
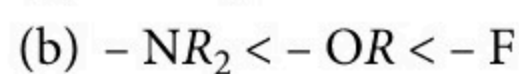
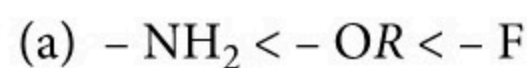
7. The correct order of acidic strength of the following carboxylic acids is



- (a) $I > II > III > IV$ (b) $II > I > IV > III$
(c) $I > III > II > IV$ (d) $III > II > I > IV$

(JEE Advanced 2019)

8. Which of the following is correct with respect to −I effect of the substituents? (R = alkyl)



(NEET 2018)

METHODS OF PURIFICATION OF ORGANIC COMPOUNDS

- Organic compounds can be purified by following methods depending upon the properties of components of mixtures :

Method	Principle	Applications
Crystallisation	Different solubilities of a given organic compound and its impurities in the same solvent.	<ul style="list-style-type: none"> Crystallisation of sugar (containing an impurity of common salt) is achieved by shaking the impure solid with hot ethanol at 348 K (sugar dissolves whereas common salt remains insoluble).
Sublimation	Some solid substances change from solid to vapour state without passing through liquid state. Sublimable compounds get separated from non-sublimable impurities.	<ul style="list-style-type: none"> Iodine from sodium chloride (as iodine sublimes readily leaving behind sodium chloride). Camphor, naphthalene, anthracene, benzoic acid, etc. are purified.
Distillation	It is used to separate <ul style="list-style-type: none"> volatile liquids from non-volatile impurities. liquids having sufficient difference in their boiling points. 	<ul style="list-style-type: none"> Hexane (b.p. 342 K) and toluene (b.p. 384 K) Chloroform (b.p. 334 K) and aniline (b.p. 457 K)
Fractional distillation	If the difference in boiling points of two liquids is not much, this method is used.	<ul style="list-style-type: none"> Crude oil in petroleum industry is separated into various useful fractions such as gasoline, kerosene oil, diesel oil, lubricating oil, etc.
Distillation under reduced pressure	It is used to purify liquids <ul style="list-style-type: none"> having very high boiling points. which decompose at or below their boiling point. 	<ul style="list-style-type: none"> Glycerol is separated from spent-lye in soap industry.
Steam distillation	This method is used to separate substances which are steam volatile, immiscible with water, possess a vapour pressure of 10–15 mm Hg and contain non-volatile impurities.	<ul style="list-style-type: none"> Aniline is separated from aniline-water mixture. Essential oils, turpentine oil, <i>o</i>-&-<i>p</i>-nitrophenol, bromobenzene, nitrobenzene, etc. can be purified.
Differential extraction	By shaking an aqueous solution of an organic compound with an organic solvent in which the organic compound is more soluble than in water. The organic solvent and the aqueous solution should be immiscible with each other so that they can form two distinct layers which can be separated by using separating funnel.	<ul style="list-style-type: none"> Benzoic acid can be extracted from its water solution using benzene.
Chromatography	Differential movement of individual components of a mixture through a stationary phase under the influence of a mobile phase.	<ul style="list-style-type: none"> Widely used for separation, purification, identification and characterisation of the components of a mixture, whether coloured or colourless.

Types of chromatography	Mobile/Stationary phase
Column chromatography	Liquid/Solid
Thin layer chromatography (TLC)	Liquid/Solid
High performance liquid chromatography (HPLC)	Liquid/Solid

Gas-liquid chromatography (GLC)	Gas/Liquid
Partition or paper chromatography	Liquid/Liquid

- Retention factor (R_f)

$$= \frac{\text{Distance travelled by the compound from base line}}{\text{Distance travelled by the solvent from base line}}$$

QUALITATIVE ANALYSIS OF ORGANIC COMPOUNDS

- In addition to carbon and hydrogen, organic compounds may also contain oxygen, nitrogen, sulphur, halogens and phosphorus. The qualitative analysis of organic compounds involves the detection of all these major elements present in it with the help of suitable chemical tests :

Element	Detection	Confirmatory test	Reactions
Carbon	Copper(II) oxide test $2\text{CuO} + \text{C} \xrightarrow{\Delta} 2\text{Cu} + \text{CO}_2\uparrow$	CO_2 gas turns lime water milky.	$\text{CO}_2\uparrow + \text{Ca(OH)}_2 \xrightarrow{\text{Lime water}} \text{CaCO}_3\downarrow + \text{H}_2\text{O}$ Milky
Hydrogen	$\text{CuO} + 2\text{H} \xrightarrow{\Delta} \text{Cu} + \text{H}_2\text{O}$	Water droplets appear on the cooler part of the ignition tube and also turns anhydrous CuSO_4 blue.	$\text{CuSO}_4 + 5\text{H}_2\text{O} \xrightarrow{\text{White}} \text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ Blue
Nitrogen	Lassaigne's extract (L.E.) $\text{Na} + \text{C} + \text{N} \xrightarrow{\Delta} \text{NaCN}$ (L.E.)	L.E. + FeSO_4 + NaOH , boil and cool + FeCl_3 + conc. HCl Gives blue or green colour.	$\text{FeSO}_4 + 2\text{NaOH} \xrightarrow{\text{L.E.}} \text{Fe(OH)}_2 + \text{Na}_2\text{SO}_4$ $\text{Fe(OH)}_2 + 6\text{NaCN} \xrightarrow{\text{L.E.}} \text{Na}_4[\text{Fe(CN)}_6] + 2\text{NaOH}$ $3\text{Na}_4[\text{Fe(CN)}_6] + 4\text{FeCl}_3 \xrightarrow{\text{HCl}} \text{Fe}_4[\text{Fe(CN)}_6]_3 + 12\text{NaCl}$ Prussian blue
Sulphur	$2\text{Na} + \text{S} \xrightarrow{\Delta} \text{Na}_2\text{S}$ (L.E.)	<ul style="list-style-type: none"> L.E. + sodium nitroprusside Gives deep violet colour. L.E. + CH_3COOH + $(\text{CH}_3\text{COO})_2\text{Pb}$ Gives black ppt. 	$\text{Na}_2\text{S} + \text{Na}_2[\text{Fe(CN)}_5\text{NO}] \xrightarrow{\text{Sodium nitroprusside}} \text{Na}_4[\text{Fe(CN)}_5\text{NOS}]$ Deep violet $\text{Na}_2\text{S} + (\text{CH}_3\text{COO})_2\text{Pb} \xrightarrow{\text{CH}_3\text{COOH}} \text{PbS}\downarrow + 2\text{CH}_3\text{COONa}$ Black ppt.
Halogens	$\text{Na} + \text{X} \xrightarrow{\Delta} \text{NaX}$ (L.E.)	L.E. + HNO_3 + AgNO_3 <ul style="list-style-type: none"> White ppt. soluble in aq. NH_3 (or NH_4OH) confirms Cl. Yellow ppt. partially soluble in aq. NH_3 (or NH_4OH) confirms Br. Yellow ppt. insoluble in aq. NH_3 (or NH_4OH) confirms I. 	$\text{NaX} + \text{AgNO}_3 \xrightarrow{\text{HNO}_3} \text{AgX}\downarrow + \text{NaNO}_3$ ppt. $\text{AgCl} + 2\text{NH}_3(\text{aq}) \xrightarrow{\text{White ppt.}} [\text{Ag(NH}_3)_2]\text{Cl} + 2\text{H}_2\text{O}$ Soluble
Nitrogen and sulphur together	$\text{Na} + \text{C} + \text{N} + \text{S} \xrightarrow{\Delta} \text{NaSCN}$ Sodium thiocyanate (L.E.)	As in test for nitrogen; instead of green or blue colour, blood red colouration confirms presence of N and S both.	$\text{NaSCN} + \text{FeCl}_3 \xrightarrow{\text{L.E.}} \text{Fe(SCN)}_3 + 3\text{NaCl}$ Blood red colour
Phosphorus	$\text{P} \xrightarrow[\Delta]{\text{Na}_2\text{O}_2, \text{boil}} \text{Na}_3\text{PO}_4$	Solution is boiled with nitric acid and then treated with ammonium molybdate, $(\text{NH}_4)_2\text{MoO}_4$. Formation of yellow ppt. indicates presence of phosphate (hence, phosphorus) in organic compound.	$\text{Na}_3\text{PO}_4 + 3\text{HNO}_3 \xrightarrow{\text{L.E.}} \text{H}_3\text{PO}_4 + 3\text{NaNO}_3$ $\text{H}_3\text{PO}_4 + 12(\text{NH}_4)_2\text{MoO}_4 + 21\text{HNO}_3 \xrightarrow{\text{L.E.}} (\text{NH}_4)_3\text{PO}_4 \cdot 12\text{MoO}_3 + 21\text{NH}_4\text{NO}_3 + 12\text{H}_2\text{O}$ Ammonium phosphomolybdate (yellow ppt.)

QUANTITATIVE ANALYSIS OF ORGANIC COMPOUNDS

- The percentage composition of elements present in an organic compound is determined by the following methods :

Element	Method
Carbon and Hydrogen	Liebig's Combustion method : $\% \text{ of C} = \frac{12}{44} \times \frac{\text{mass of CO}_2 \text{ formed}}{\text{mass of compound taken}} \times 100; \quad \% \text{ of H} = \frac{2}{18} \times \frac{\text{mass of H}_2\text{O formed}}{\text{mass of compound taken}} \times 100$
Nitrogen	Dumas method : $\% \text{ of N} = \frac{28}{22400} \times \frac{\text{vol. of N}_2 \text{ at STP}}{\text{mass of compound taken}} \times 100$ Kjeldahl's method : $\% \text{ of N} = \frac{1.4 \times \text{molarity of acid} \times \text{vol. of acid used} \times \text{basicity of acid}}{\text{mass of compound taken}}$
Halogens	Carius method : $\% \text{ of X} = \frac{\text{At. mass of X}}{108 + \text{At. mass of X}} \times \frac{\text{mass of AgX formed}}{\text{mass of compound taken}} \times 100$
Sulphur	Carius method : $\% \text{ of S} = \frac{32}{233} \times \frac{\text{mass of BaSO}_4 \text{ formed}}{\text{mass of compound taken}} \times 100$
Phosphorus	Ignition method : $\% \text{ of P} = \frac{62}{222} \times \frac{\text{mass of Mg}_2\text{P}_2\text{O}_7 \text{ formed}}{\text{mass of compound taken}} \times 100$
Oxygen	Iodine method : $\% \text{ of O} = \frac{16}{44} \times \frac{\text{mass of CO}_2 \text{ formed}}{\text{mass of compound taken}} \times 100 \quad \text{or} \quad \% \text{ of O} = \frac{5 \times 16}{2 \times 127} \times \frac{\text{mass of I}_2 \text{ formed}}{\text{mass of compound taken}} \times 100$

PEEP INTO PREVIOUS YEARS

9. The correct match between items I and II is

Item-I (Mixture)	Item-II (Separation method)
(A) H ₂ O : Sugar	(P) Sublimation
(B) H ₂ O : Aniline	(Q) Recrystallization
(C) H ₂ O : Toluene	(R) Steam distillation
	(S) Differential extraction
(a) (A) → (Q); (B) → (R); (C) → (S)	
(b) (A) → (R); (B) → (P); (C) → (S)	
(c) (A) → (Q); (B) → (R); (C) → (P)	
(d) (A) → (S); (B) → (R); (C) → (P)	

(JEE Main 2019)

10. Two compounds I and II are eluted by column chromatography (adsorption of I > II). Which one of the following is a correct statement?

- (a) II moves faster and has higher R_f value than I.
 (b) I moves faster and has higher R_f value than II.
 (c) II moves slower and has higher R_f value than I.
 (d) I moves slower and has higher R_f value than II.

(JEE Main Online 2018)

11. The most suitable method of separation of 1 : 1 mixture of *ortho* and *para*-nitrophenols is
 (a) chromatography (b) crystallisation
 (c) steam distillation (d) sublimation.

(NEET 2017)

POINTS FOR EXTRA SCORING

- The problems on structural isomerism and structure determination of organic molecules can be easily solved by the concept of double bond equivalents (D.B.E.) which implies the sum of double bonds and rings present in the molecule.

- It is given by the relation, $D.B.E. = \frac{\sum n(v-2)}{2} + 1$ where, n is the number of different kinds of atoms present in the molecule and v is the valency of each atom.
- Terminal alkenes like propene, isobutylene, 2, 3-dimethylbutene do not show geometrical isomerism.
- Out of pair of geometrical isomers (*cis* and *trans*), *cis* isomer has higher boiling point, density and refractive index.
- When a molecule is unsymmetric and contain n chiral carbon atoms

Number of optical isomers = 2^n

Number of *meso* isomers = 0

- When the molecule is symmetric and has even number of chiral carbon atoms

Number of *d* and *l* isomers = 2^{n-1}

Number of *meso* isomers = $2^{\frac{n}{2}-1}$

- When molecule is symmetric and has odd number of chiral carbon atoms

Number of *d* and *l* forms = $2^{n-1} - 2^{\frac{n-1}{2}}$

Number of *meso* forms = $2^{\frac{n-1}{2}}$

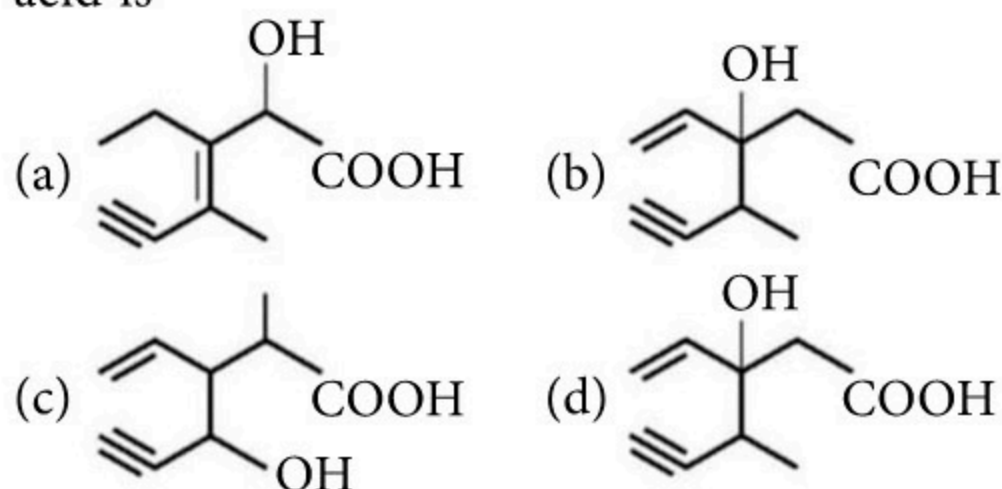
Answer Key For Peep Into Previous Years

- | | | | | | |
|--------|-----------|--------|---------|---------|--------|
| 1. (a) | 2. (b) | 3. (d) | 4. (a) | 5. (d) | 6. (c) |
| 7. (a) | 8. (a, b) | 9. (a) | 10. (a) | 11. (c) | |



WRAP it up!

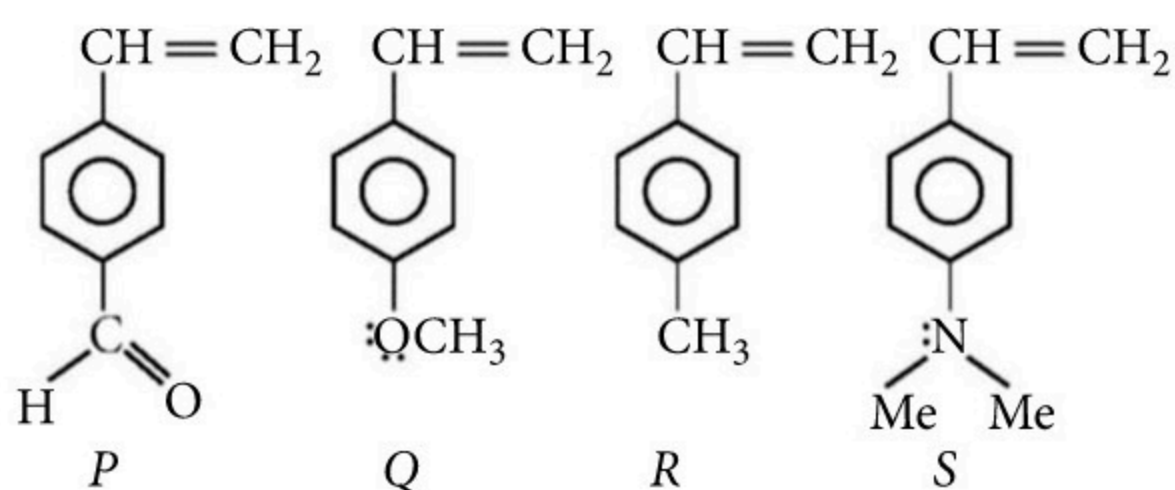
1. Structure of the compound whose IUPAC name is 3-ethyl-2-hydroxy-4-methylhex-3-en-5-yn-1-oic acid is



2. Complete combustion of a hydrocarbon gives 0.66 g of CO_2 and 0.36 g of H_2O . Then the empirical formula of the compound is

(a) C_3H_8 (b) C_2H_2 (c) C_5H_{10} (d) CH_4

3. Arrange the following compounds in decreasing order of rate of electrophilic addition reaction.



- (a) $Q > S > P > R$ (b) $S > Q > R > P$
 (c) $P > Q > R > S$ (d) $R > Q > S > P$

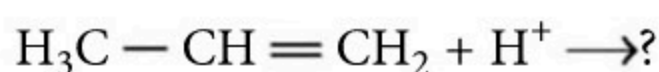
4. A straight chain hydrocarbon has the molecular formula C_8H_{10} . The hybridization of the carbon atoms from one end of the chain to the other are respectively sp^3 , sp^2 , sp^2 , sp^3 , sp^2 , sp^2 , sp and sp . The structural formula of the hydrocarbon would be

(a) $\text{CH}_3\text{C} \equiv \text{CCH}_2 - \text{CH} = \text{CHCH} = \text{CH}_2$
 (b) $\text{CH}_3\text{CH}_2 - \text{CH} = \text{CHCH} = \text{CHC} \equiv \text{CH}$
 (c) $\text{CH}_3\text{CH} = \text{CHCH}_2 - \text{C} \equiv \text{CCH} = \text{CH}_2$
 (d) $\text{CH}_3\text{CH} = \text{CHCH}_2 - \text{CH} = \text{CHC} \equiv \text{CH}$

5. In the Carius method of estimation (a gravimetric determination of phosphorus, 0.248 g of an organic compound gave a precipitate of $\text{Mg}_2\text{NH}_4\text{PO}_4$ which on ignition yielded 0.444 g of $\text{Mg}_2\text{P}_2\text{O}_7$. What is the percentage of phosphorus in the compound?
 (a) 68% (b) 50% (c) 42% (d) 78%

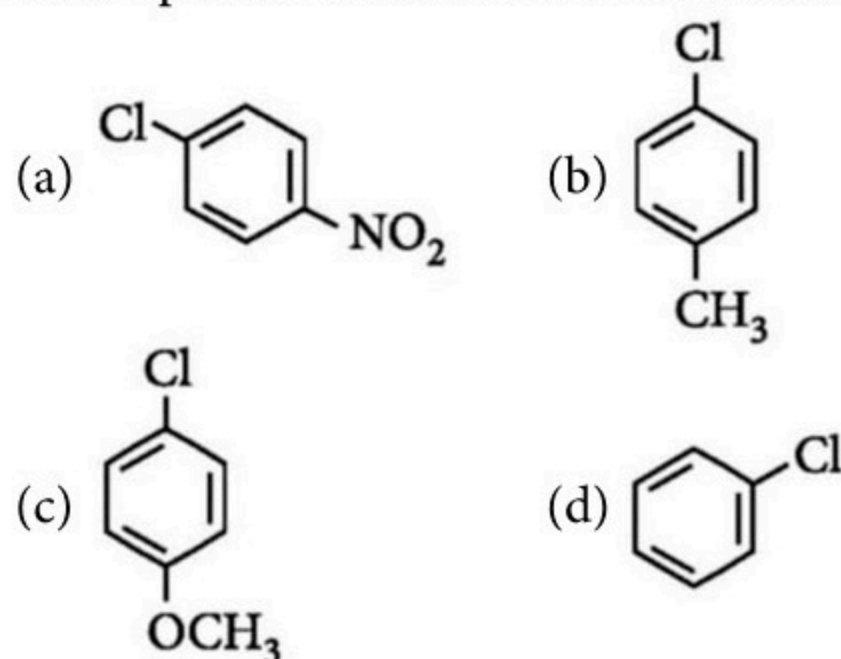
6. 0.532 g of chloroplatinate of an organic base (mol wt. 244) gave 0.195 g of platinum on ignition. The number of nitrogen atoms per molecule of base is
 (a) 1 (b) 2 (c) 3 (d) 4

7. Electrophilic addition reactions proceed in two steps. The first step involves the addition of an electrophile. Name the more stable intermediate formed in the first step of the following addition reaction.



- (a) 2° Carbanion (b) 1° Carbocation
(c) 2° Carbocation (d) 1° Carbanion

8. An organic compound contains 49.3% carbon, 6.84% hydrogen and remaining oxygen. Its vapour density is 73. Molecular formula of the compound is
(a) $\text{C}_3\text{H}_5\text{O}_2$ (b) $\text{C}_6\text{H}_{10}\text{O}_4$
(c) $\text{C}_3\text{H}_{10}\text{O}_2$ (d) $\text{C}_4\text{H}_{10}\text{O}_2$
9. Which of the following compounds undergoes nucleophilic substitution reaction most easily?

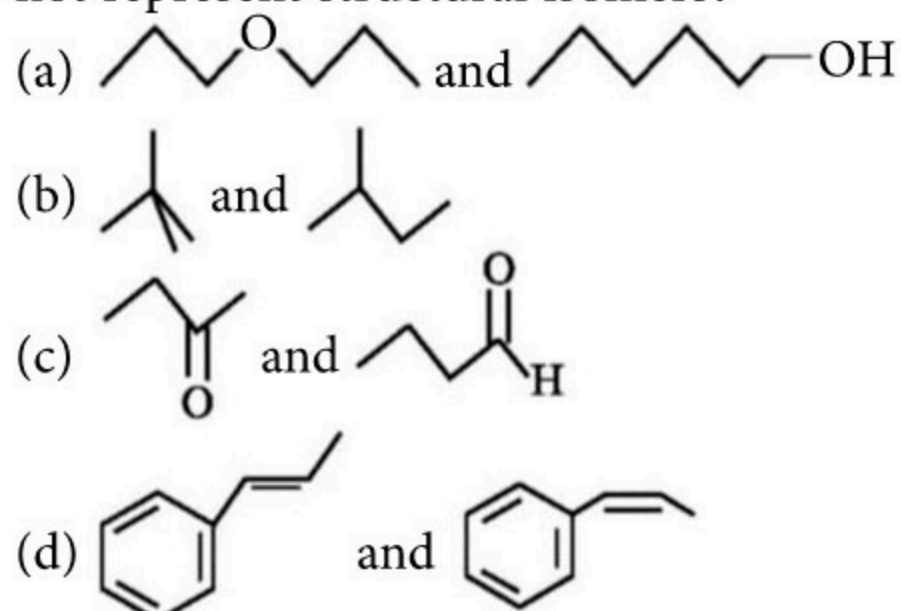


10. The stability of carbanions in the following

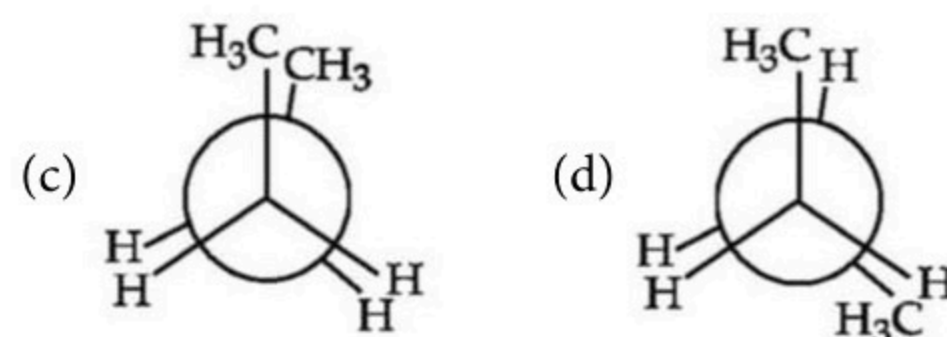
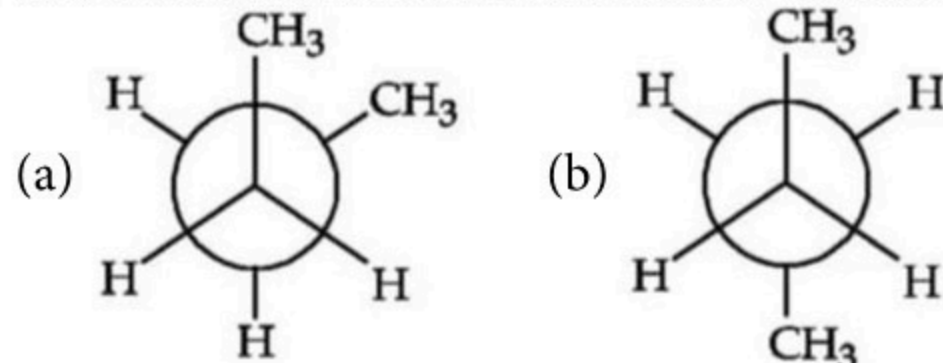


is in the order

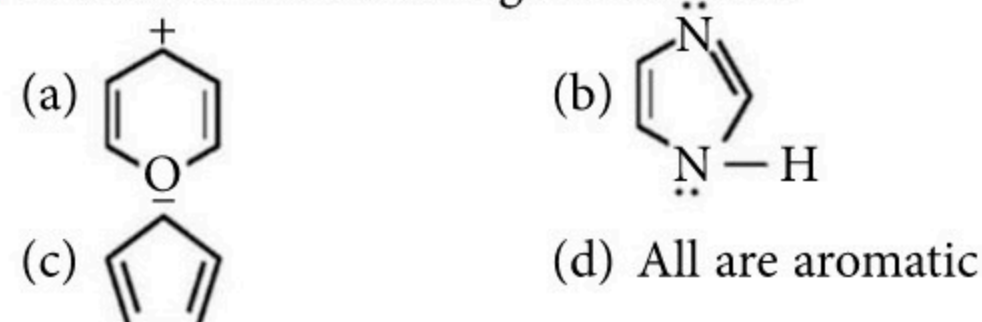
- (a) (ii) > (iii) > (iv) > (i)
(b) (iv) > (ii) > (iii) > (i)
(c) (i) > (iii) > (ii) > (iv)
(d) (i) > (ii) > (iii) > (iv)
11. Which of the following pairs of compounds does not represent structural isomers?



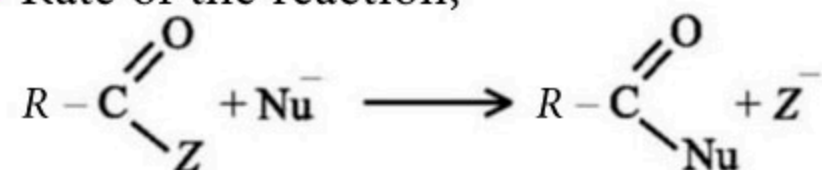
12. The most stable conformation of *n*-butane is



13. Which of the following is aromatic?



14. Rate of the reaction,

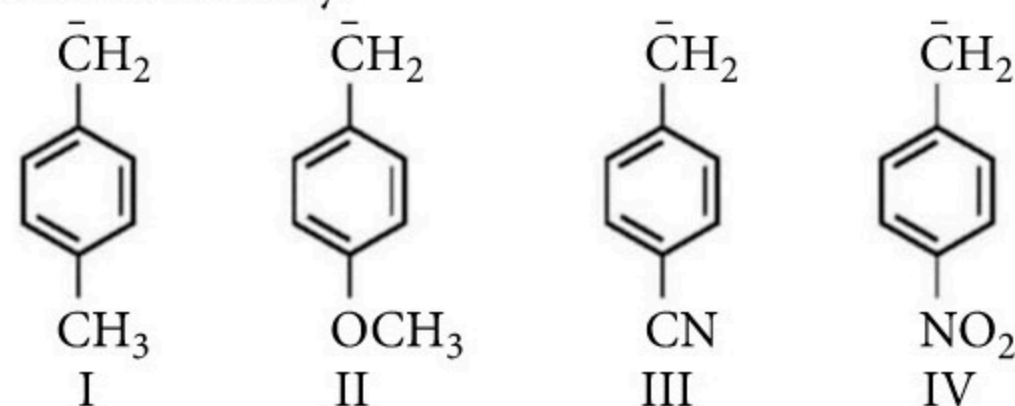


is fastest when Z is

- (a) Cl (b) NH_2
(c) OC_2H_5 (d) OCOCH_3
15. Which of the following is the most stable carbocation?



16. Arrange the following carbanions in decreasing order of stability.



- (a) I > III > II > IV (b) III > IV > II > I
(c) IV > III > I > II (d) II > I > III > IV
17. 0.765 g of an acid gives 0.535 g of CO_2 and 0.138 g of H_2O . Then the ratio of the percentage of carbon and hydrogen is

- (a) 1 : 9 (b) 20 : 16 (c) 18 : 11 (d) 19 : 2

NEW LAUNCH

mtg

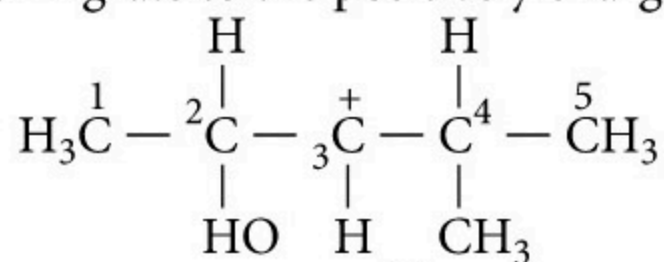
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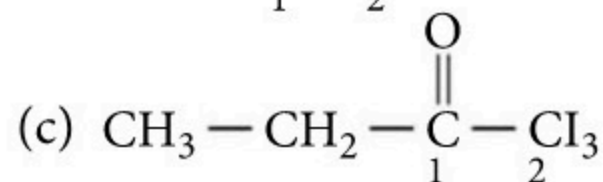
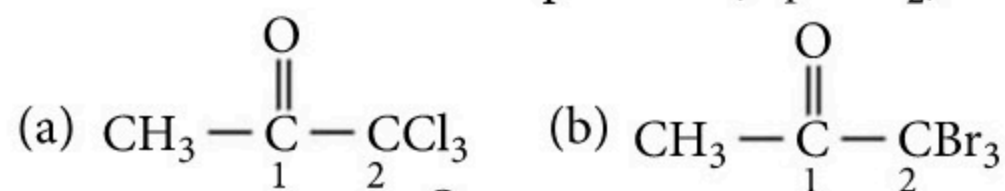
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18. In the following carbocation, H^+/CH_3 that is most likely to migrate to the positively charged carbon is



- (a) CH_3 at C-4 (b) H at C-4
(c) CH_3 at C-2 (d) H at C-2
19. Which of the following compounds yields most stable carbanion after rupture of $(C_1 - C_2)$ bond?



20. Consider thiol anion (RS^-) and alkoxy anion (RO^-). which of the following statement is correct ?
(a) RS^- is less basic and less nucleophilic than RO^-
(b) RS^- is less basic but more nucleophilic than RO^-
(c) RS^- is more basic and more nucleophilic than RO^-
(d) RS^- is more basic but less nucleophilic than RO^-

SOLUTIONS

1. (a)

2. (a): Let the mass of the substance taken = w g

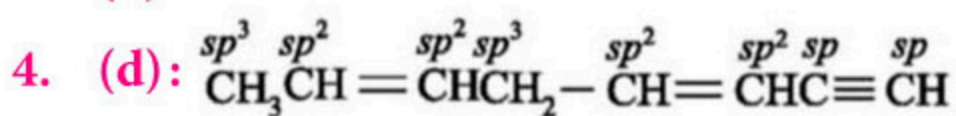
$$\therefore \% C = \frac{12}{44} \times \frac{0.66}{w} \times 100 = \frac{18}{w}$$

$$\text{and } \% H = \frac{2}{18} \times \frac{0.36}{w} \times 100 = \frac{4}{w}$$

$$\text{Ratio of atoms, } C:H = \frac{18}{w} \times \frac{1}{12} : \frac{4}{w} \times \frac{1}{1} = 3:8$$

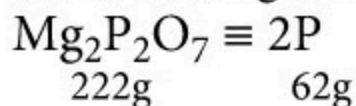
Hence, empirical formula = C_3H_8 .

3. (b)



5. (b): Mass of organic compound = w g

Mass of magnesium pyrophosphate = w_1 g



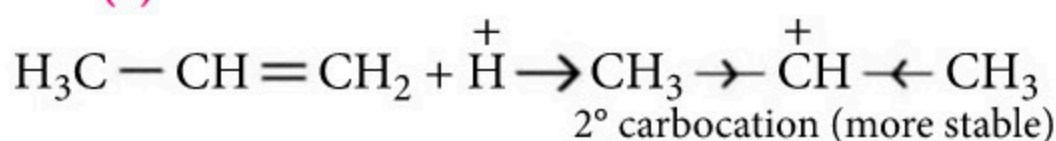
$$\% \text{ of P} = \frac{62}{222} \times \frac{w_1}{w} \times 100$$

$$= \frac{62}{222} \times \frac{0.444}{0.248} \times 100 = \frac{2752.8}{55.056} = 50\%$$

6. (d): $\frac{2E + 410}{195} = \frac{\text{Mass of platinum salt}}{\text{Mass of platinum}} = \frac{0.532}{0.195}$
 $E = 61$

$$\text{Number of nitrogen atoms per molecule of base} = \frac{244}{61} = 4$$

7. (c):



8. (b):

Element	C	H	O
Percentage	49.3	6.84	$100 - (49.3 + 6.84)$ $= 43.86$
Atomic ratio	$49.3/12$ $= 4.10$	$6.84/1$ $= 6.84$	$43.86/16$ $= 2.74$
Simplest ratio	$4.10/2.74$ $= 1.5$	$6.84/2.74$ $= 2.5$	$2.74/2.74$ $= 1$
Simple whole no. ratio	3	5	2

Hence empirical formula is $C_3H_5O_2$.

Empirical formula mass = $3 \times 12 + 5 \times 1 + 2 \times 16 = 73$

Molecular mass = $73 \times 2 = 146$

$$n = \frac{\text{Molecular mass}}{\text{Empirical formula mass}} = \frac{146}{73} = 2$$

Hence, molecular formula = (Empirical formula)_n
 $= C_6H_{10}O_4$.

9. (a): Electron withdrawing groups like $-NO_2$ facilitates nucleophilic substitution reaction in chlorobenzene.

10. (d)

11. (d): It represents *cis-trans* isomerism which is an example of stereoisomerism.

12. (b)

13. (d): (a), (b), (c), all are aromatic because all have 6 π electrons in delocalisation and obey Huckel's rule.

14. (b): Acid halides are most reactive.

15. (c)

16. (c)

17. (d): $\% \text{ of C} = \frac{12}{44} \times \frac{0.535}{0.765} \times 100 = 19.07\%$

$$\% \text{ of H} = \frac{2}{18} \times \frac{0.138}{0.765} \times 100 = 2.004$$

C : H = 19 : 2

18. (d)

19. (a)

20. (b)

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CBSE

warm-up!

CLASS-XI

Chapterwise practice questions for CBSE Exams as per the latest pattern and marking scheme issued by CBSE for the academic session 2019-20.

Series 7

Hydrocarbons | Environmental Chemistry

Time Allowed : 3 hours
Maximum Marks : 70

GENERAL INSTRUCTIONS

- All questions are compulsory.
- Section A: Q.no. 1 to 20 are very short answer questions (objective type) and carry 1 mark each.
- Section B: Q.no. 21 to 27 are short answer questions and carry 2 marks each.
- Section C: Q.no. 28 to 34 are long answer questions and carry 3 marks each.
- Section D: Q.no. 35 to 37 are also long answer questions and carry 5 marks each.
- There is no overall choice. However an internal choice has been provided in two questions of two marks, two questions of three marks and all the three questions of five marks weightage. You have to attempt only one of the choices in such questions.
- Use log tables if necessary, use of calculators is not allowed.

SECTION - A

Read the given passage and answer the questions 1 to 5 that follow :

Alkenes and alkynes undergo electrophilic addition reactions but alkynes are less reactive than alkenes in these reactions even though they contain two π -bond. Although the addition of unsymmetrical reagents to unsymmetrical alkenes and alkynes generally occurs in accordance with Markovnikov's rule, yet there are many exceptions.

- Name the product formed when propene react with chlorine water.
- What do you understand by the Markovnikov's rule?
- Complete the following reaction :
 $\text{CH}_3-\text{CH}=\text{CH}_2 + \text{HBr} \longrightarrow$ (KVS 2017)
- How will you separate propene from propyne?

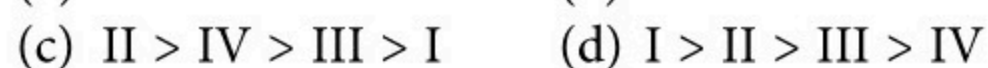
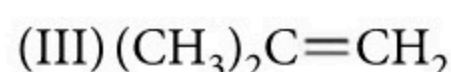
- Write IUPAC name of the products obtained by addition reactions of HBr to hex-1-ene in the presence of peroxide.

Questions 6 to 10 are one word answers :

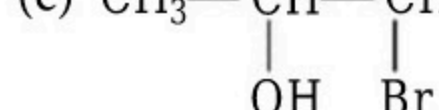
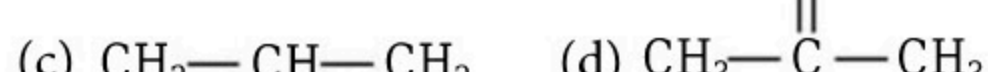
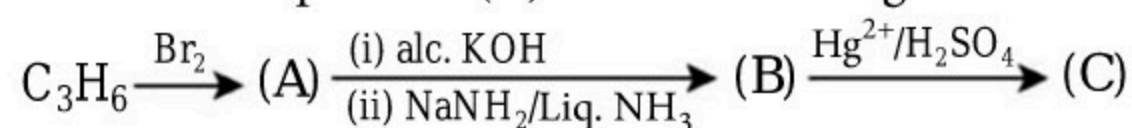
- Amongst the following, which one has the maximum boiling point?
n-Pentane, *iso*-pentane, *neo*-pentane
- What will be the product formed on heating a mixture of sodium benzoate and sodalime?
- What type of aromatic compounds are present as particulates in the air?
- What will be the product formed or partial oxidation of methane at controlled high temperature?
- How many isomeric forms are possible for $\text{C}_2\text{H}_2\text{Cl}_2$?

Questions 11 to 15 are multiple choice questions :

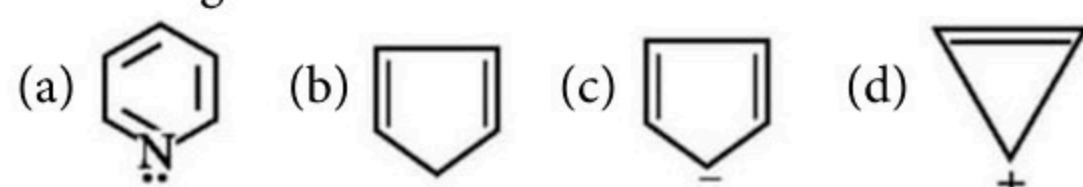
- What is correct order of acid catalysed hydration of following alkene?
(I) $\text{CH}_2=\text{CH}_2$ (II) $\text{CH}_3-\text{CH}=\text{CH}_2$



12. Predict the product (C) for the following :



13. Which of the following compounds is not aromatic according to Huckle's rule?



14. The restricted rotation about carbon-carbon double bond in 2-butene is due to

- (a) overlap of one s and one sp^2 -hybridized orbitals
(b) overlap of two sp^2 -hybridized orbitals
(c) overlap of one sp and one sp^2 -hybridized orbitals
(d) sideways overlap of two p-orbitals.

15. Which one of the following is responsible for depletion of the ozone layer in the upper strata of the atmosphere?

- (a) Polyhalogens (b) Ferrocene
(c) Fullerenes (d) Freons

Questions 16 to 20 :

- (a) Both assertion and reason are correct statements, and reason is the correct explanation of the assertion.
(b) Both assertion and reason are correct statements, but reason is not the correct explanation of the assertion.
(c) Assertion is correct, but reason is wrong statement.
(d) Assertion is wrong, but reason is correct statement.

16. **Assertion :** Mists are non-viable particulates produced by particles of spray liquids and by condensation of vapours in air.

Reason : Herbicides and insecticides that miss their targets, travel through air and form mists.

17. **Assertion :** Addition of Br_2 to 1-butene gives two optical isomers.

Reason : The product contains one asymmetric carbon.

18. **Assertion :** The amount of BOD in the water is a

measure of the amount of organic material in the water.

Reason : Clear water has BOD less than 5 ppm whereas highly polluted water can have BOD value of 17 ppm or more.

19. **Assertion :** Cyclopentadienyl anion is aromatic in nature.

Reason : Cyclopentadienyl anion has six π electrons.

20. **Assertion :** Manures and biofertilizers should be used in place of chemical fertilizers.

Reason : Chemical fertilizers cause pollution by releasing excess nutrients in water bodies.

SECTION - B

21. Write the structure of alkanes obtained when ethyl bromide and isopropyl bromide react under Wurtz condition.

22. What do you mean by green chemistry? How will it help in decreasing environmental pollution? Explain with the help of example.

(NCERT, KVS 2008, NCT 2017)

OR

A large number of fish are suddenly found floating dead on a lake. There is no evidence of toxic dumping but you find an abundance of phytoplankton. Suggest a reason for the fish killing.

23. Convert (i) Hexane into 2-methylpentane
(ii) Hexane into benzene

24. Why is London smog formed in winter while photochemical smog is formed in summer?

25. State with balanced equations, what happens when :
(i) propene is bubbled through a hot aqueous solution of potassium permanganate.
(ii) butanoic acid is heated with soda lime at 630 K.

OR

Explain with example : Acidic dehydration.

26. How will you convert ethyne to but-2-yne?

(KVS 2017)

27. At one time, handpump water was considered to be pure and used freely for drinking in villages but not now. Why?

SECTION - C

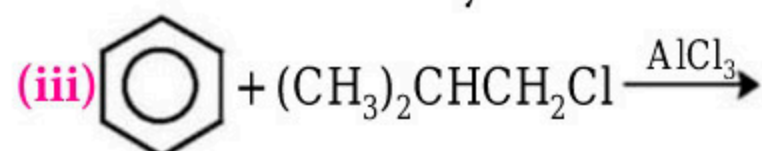
28. (a) What do you understand by dissolved oxygen and what are the major sources of dissolved oxygen in water?

(b) What are the BOD values for

(i) pure water (ii) city sewage.

29. Write the structural formula of the major product in each of the following cases :

- (i) Compound obtained by hydration of ethyne.
 (ii) Ethene mixed with air is passed under pressure over a silver catalyst at 250°C.



OR

How many atoms of oxygen are required for the complete combustion of 5.8 g of butane?

30. Write a brief note on the following environmental terms :

- (i) Acid rain (ii) Greenhouse effect
 (iii) Ozone layer depletion (NCT 2011, 2013, 2019)

31. (a) Write down the anodic and cathodic reactions when sodium ethanoate is electrolysed by Kolbe's electrolytic method.

(b) Write the names and formulae of the chief constituents of light and heavy oil fractions of coal tar.

32. Predict the product and show the mechanism during the addition of HBr over cyclobutylethylene.

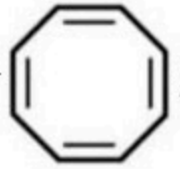
OR

Give the structures of the major organic products from 3-ethyl-2-pentene under each of the following reaction conditions :

- (a) HBr in the presence of peroxide
 (b) Br₂/H₂O
 (c) Hg(OAc)₂/H₂O; NaBH₄

33. An organic compound A with molecular formula C₃H₈O reacts with conc. H₂SO₄ to give B, which on reaction with HCl gives C. Compound C reacts with metallic sodium to give D. Identify compounds A, B, C and D. (2018)

34. (a) Write a short note on hydrogenation of unsaturated aliphatic hydrocarbons.

(b) Explain why  is not aromatic?

SECTION - D

35. An alkyl halide C₅H₁₁Br (A) reacts with ethanolic KOH to give an alkene 'B', which reacts with Br₂ to give a compound 'C', which on dehydrobromination gives an alkyne 'D'. On treatment with sodium metal in liquid ammonia one mole of 'D' gives one mole of the sodium salt of 'D' and half a mole of hydrogen gas. Complete hydrogenation of 'D' yields a straight chain alkane. Identify A, B, C and D. Give the reactions involved.

OR

Give reasons for the following :

- (i) Toluene reacts with bromine in the presence of light to give benzyl bromide while in presence of FeBr₃ it gives *p*-bromotoluene. Give explanation for the above observations.
 (ii) Explain very briefly why alkynes are generally less reactive than alkenes towards electrophilic reagents such as H⁺.
 (iii) The central carbon-carbon bond in 1, 3 - butadiene is shorter than that of *n*-butane.

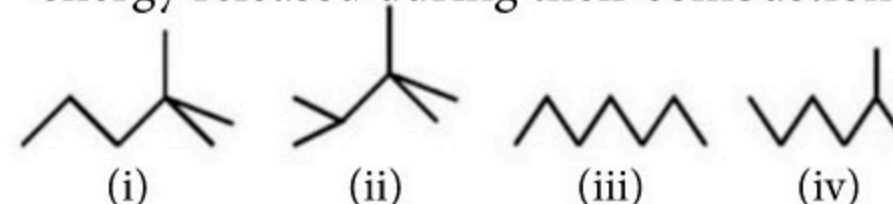
36. (a) How green chemistry has helped in the dry cleaning of clothes and laundry?
 (b) How does improper management of industrial and domestic waste contribute to pollution?
 (c) In which part of the atmosphere, ozone is formed and how?

OR

- (a) For your agricultural field or garden you have developed a compost producing pit. Discuss the process in the light of bad odour, flies and recycling of wastes for a good produce.
 (b) What is COD? Which chemical substance is generally used in its measurement?
 (c) What do you mean by ozone hole? What are its consequences?

37. (i) (a) Arrange the following halogens in increasing order of reactivity towards alkanes :
 F₂, Cl₂, Br₂, I₂

(b) Arrange the following in increasing order of energy released during their combustion.



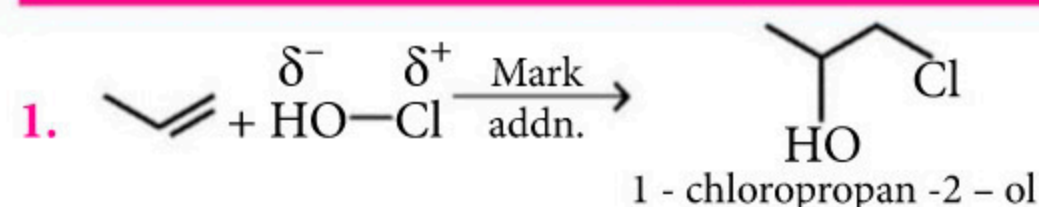
(c) Arrange the following in the increasing order of C — C bond length : C₂H₆, C₂H₄, C₂H₂

(ii) Draw Newman and Sawhorse projections of ethane molecule (Eclipsed form). (2019)

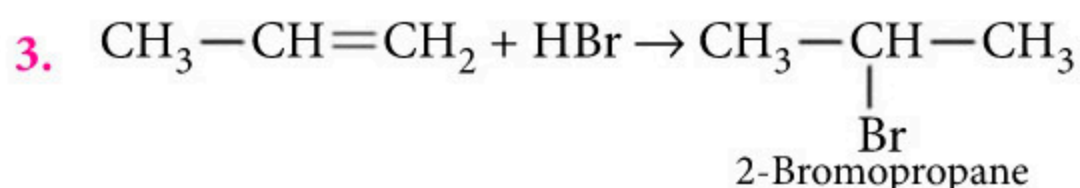
OR

A hydrocarbon (A) gives white precipitate with Tollens' reagent which reacts with *n*-propyl iodide to give (B). (B) on partial reduction gives (C) which on ozonolysis gives 2, 2-dimethylpropanal (D) along with butanal. Assign structure of (A).

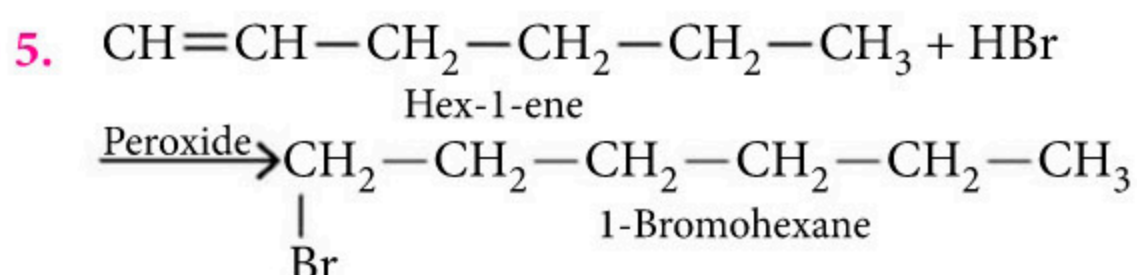
SOLUTIONS



2. Markovnikov's rule states that the positive part of the addendum gets attached to that carbon atom in alkene which possesses more number of hydrogen atoms.



4. On passing the mixture through ammoniacal AgNO_3 solution or ammoniacal CuCl solution propyne reacts while propene passes over.



6. *n*-pentane

7. Benzene

8. Polycyclic aromatic hydrocarbons (PAH)

9. Acetylene

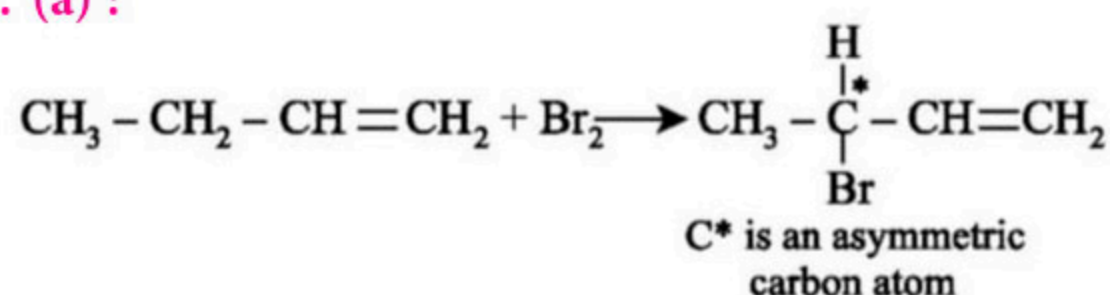
10. Three

11. (b) 12. (d)

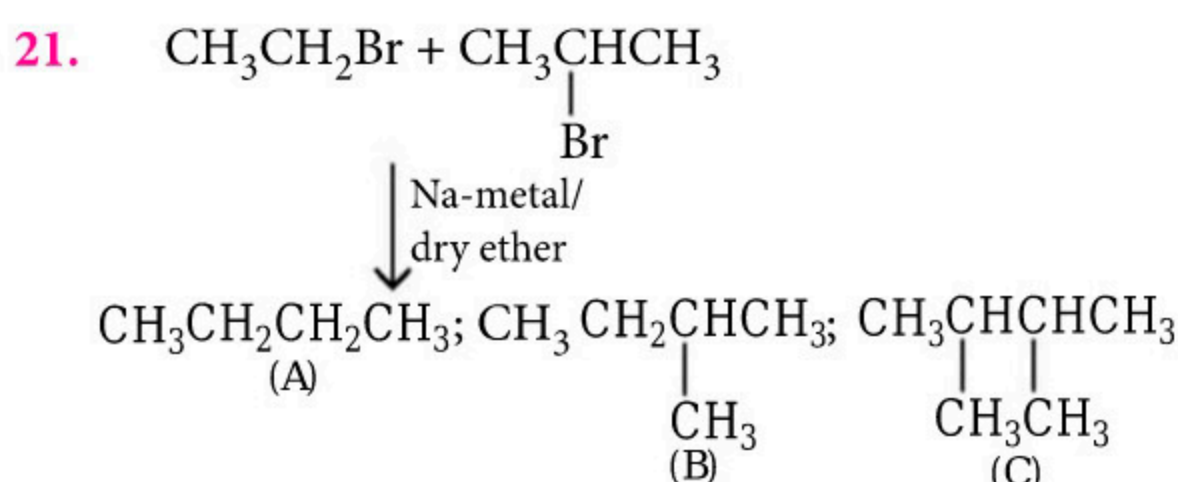
13. (b) : It contains only four π -electrons and thus, it does not obey Huckel's rule. Due to presence of sp^3 -hybridised carbon atom, the system is not planar. Therefore, it is not aromatic.

14. (d) 15. (d) 16. (b)

17. (a) :



18. (b) 19. (a) 20. (a)



22. Green chemistry is a production process that would bring about minimum pollution or deterioration to the environment.

Green chemistry aims at :

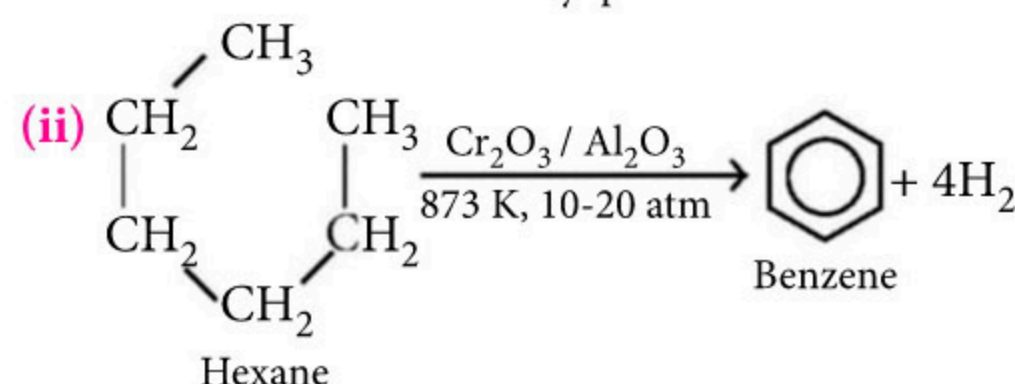
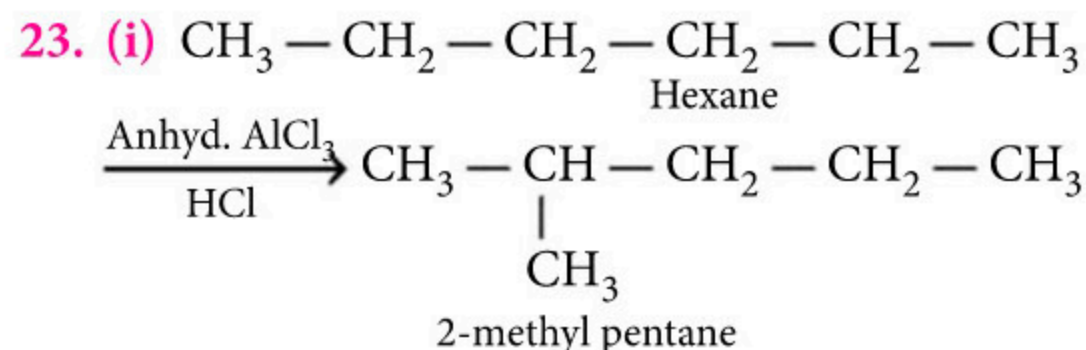
(a) Use of environment friendly medium for the reaction.

(b) Use of methods that completely convert the reactants to products such that there are no harmful side-products formed.

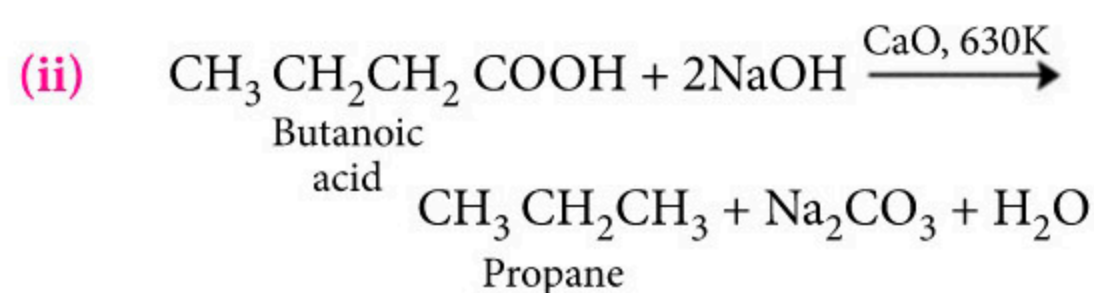
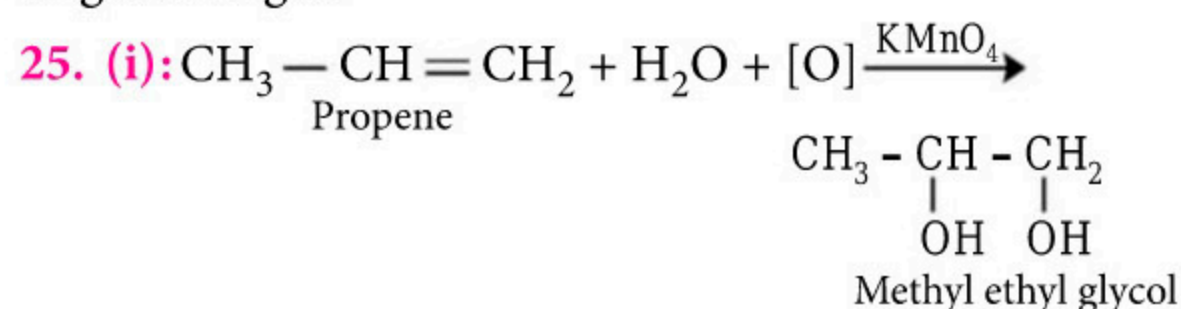
This is arrived by working out at optimum conditions for synthesis such that there are no harmful side-products formed. Thus, green chemistry produce products which have no adverse impact on the environment.

OR

If BOD value is 17 ppm or more, then fish cannot survive because amount of dissolved oxygen decreases which is not sufficient for fish to survive. Phytoplankton absorbs lot of oxygen and amount of dissolved oxygen will decrease.

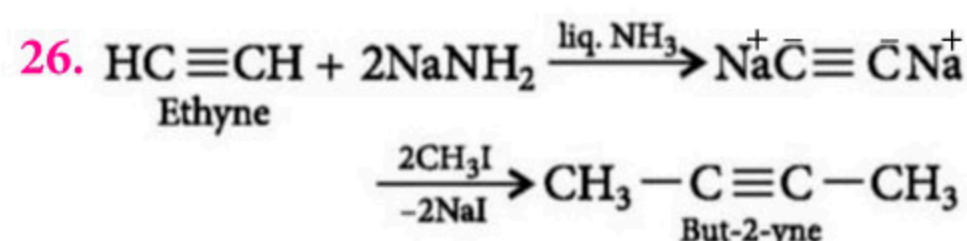
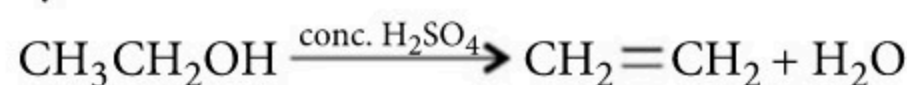


24. London smog is formed due to condensation of sulphuric acid droplets (formed from SO_2) on the surface of the particulates which takes place in cold weather while photochemical smog is initiated by the photolysis of NO_2 which takes place in presence of bright sunlight.



OR

Acidic dehydration : Alcohols on heating with conc. H_2SO_4 form alkenes with elimination of one water molecule. Since, a water molecule is lost in the presence of acid, the reaction is called acidic dehydration of alcohols.



27. Handpump water is ground water. It collects below the surface of the earth after passing through the pores of the earthy materials which act as a filter for it so, it is pure. Now, due to disposal of domestic wastes and industrial effluents and use of fertilizers and pesticides, a number of harmful soluble substances dissolve into rain water and pass through the soil and enter into ground water resulting in water pollution. Therefore, it is unfit for drinking.

28. (a) Dissolved oxygen is the amount of gaseous oxygen dissolved in water.

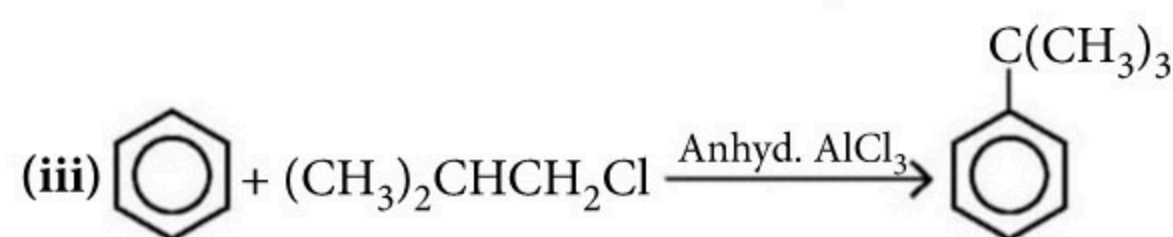
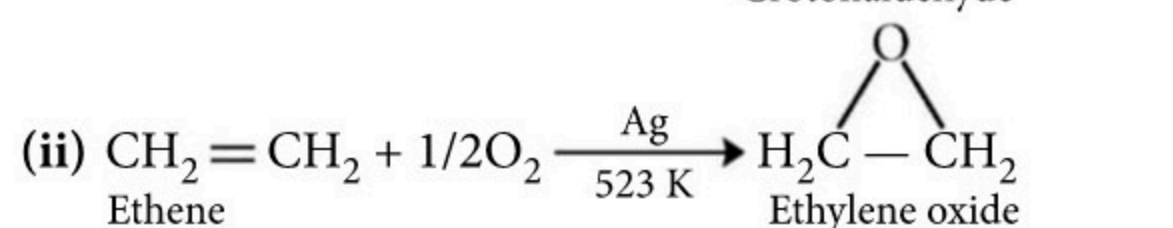
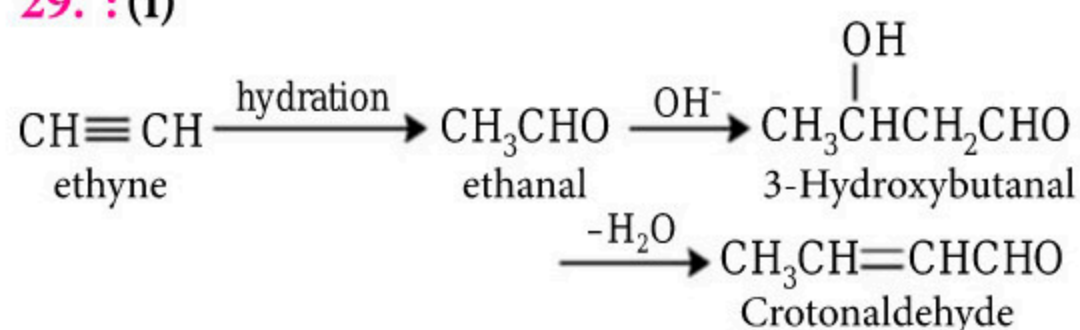
There are two major sources of dissolved oxygen in water :

(i) Atmospheric oxygen : Water takes up oxygen from the air until it gets saturated with oxygen.

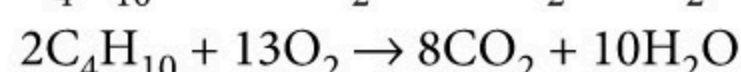
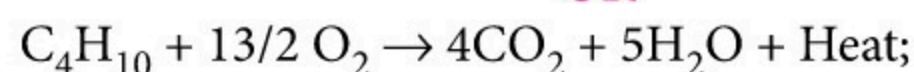
(ii) Photosynthesis : Many green aquatic plants such as algae release oxygen during photosynthesis. The water takes up this oxygen and it gets saturated with oxygen during the day time. After sunset, the photosynthesis stops but the plants continue to respire with a net decreasing effect on the amount of the dissolved oxygen in water.

(b) (i) < 5 ppm (ii) 100-500 ppm

29. : (i)



OR



By equation it is clear that during the combustion of 2 moles of butane, 13 moles of oxygen molecules or $13 \times N_0$ molecules of oxygen (N_0 = Avogadro's number) or $13 \times 2 \times N_0$ atoms of oxygen is required.

2×58 g butane require $13 \times 2 \times N_0$ atoms

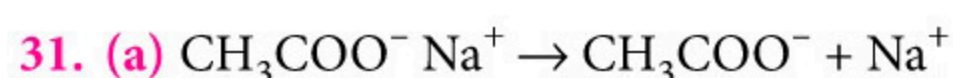
\therefore 5.8 g butane require $\frac{5.8 \times 13 \times 2 \times N_0}{2 \times 58} = 1.3 \times N_0$ atoms.

30. (i) Acid rain : Acid rain is caused by the presence of oxides of sulphur and nitrogen and CO_2 in the atmosphere. When pH of the rain drops below 5.6, it becomes acidic.

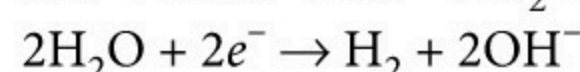
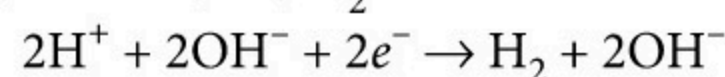
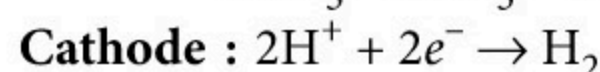
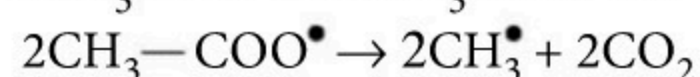
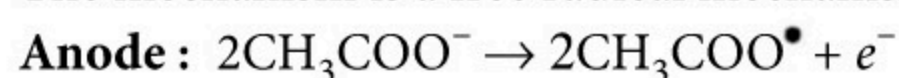
(ii) Greenhouse effect : Greenhouse effect is the trapping of the sun's radiation in a glass house, the glass does not allow this heat energy to escape. The same situation is observed in a car parked in the sun, the inside of the car becomes hot. There are some gases, called the greenhouse gases (such as CO_2 , CH_4 , ozone etc.) present in the atmosphere which absorb the IR radiations coming from the sun and cause global warming.

(iii) Ozone layer depletion : Excessive thinning of ozone layer when more than half of the ozone gas in a particular area is depleted and harmful ultraviolet rays can pass through to reach the earth's surface is known as ozone layer depletion.

Nitric oxide (NO) and Chlorofluorocarbons (CFCs) gases are main factors of ozone layer depletion.

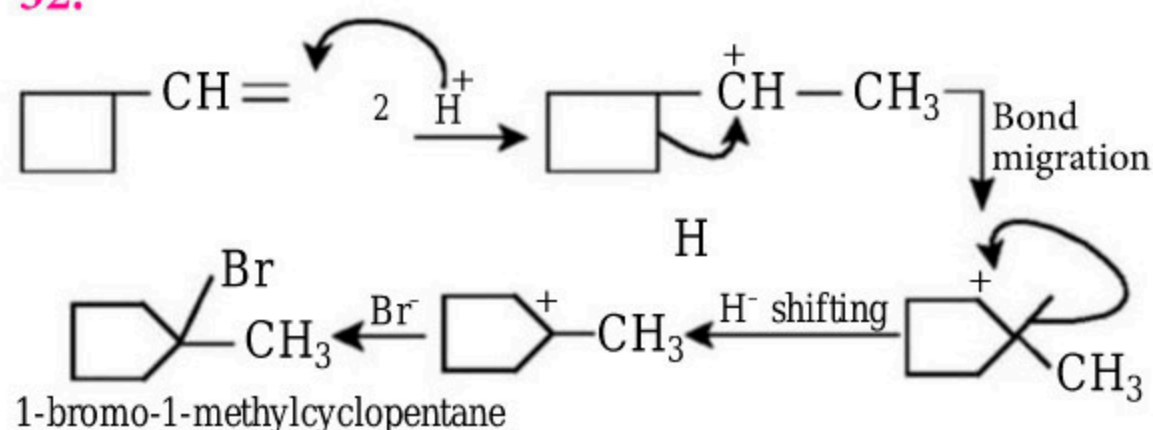


The mechanism is a free radical mechanism.



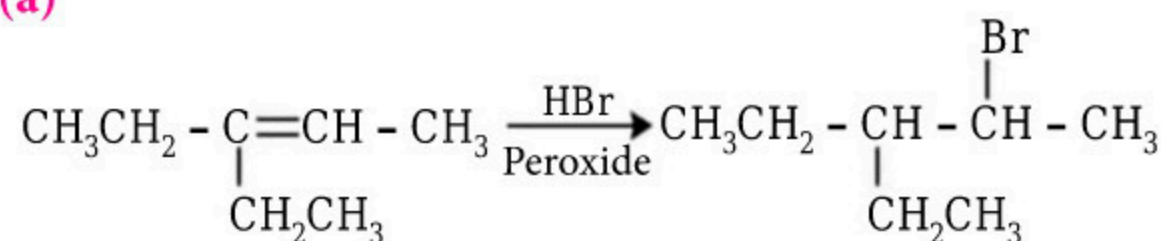
(b) Light oil fraction : Benzene, Toluene and xylene.
Heavy oil fraction : Cresol and naphthol.

32.

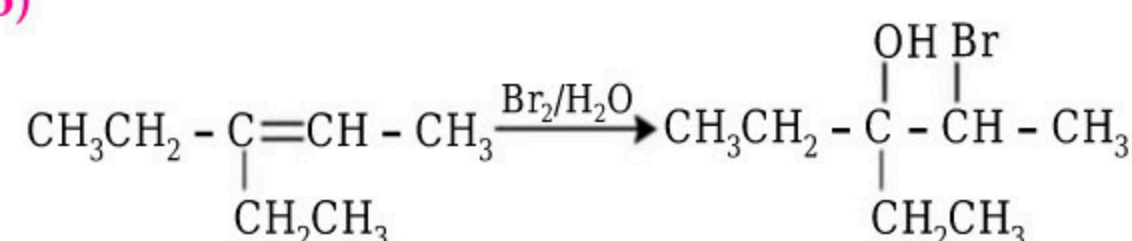


OR

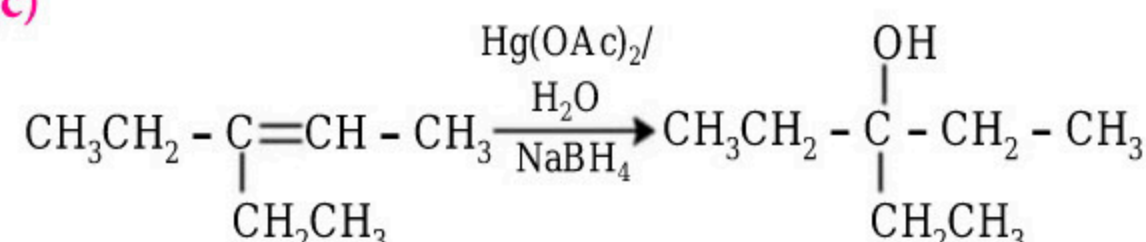
(a)



(b)



(c)



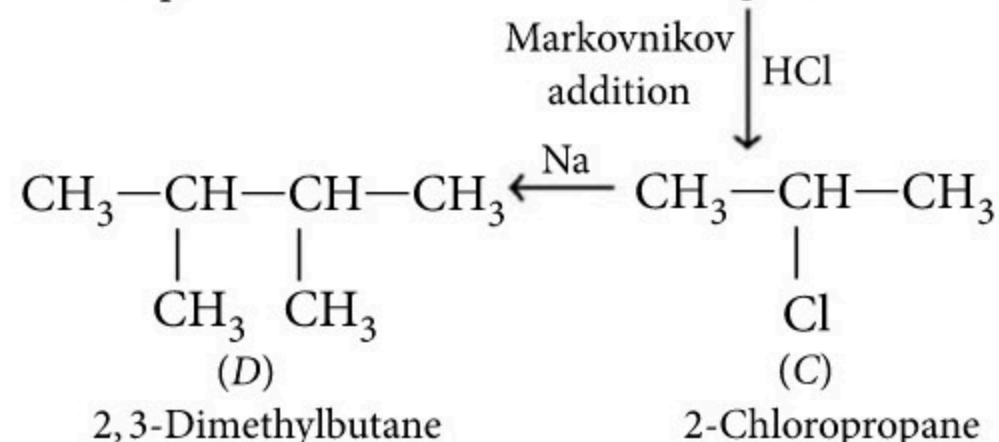
$$\text{CH}_3\text{CH}_2\text{CH}_2\text{OH} \xrightarrow[\text{H}_2\text{SO}_4]{\text{Conc.}} \text{CH}_3\text{CH}=\text{CH}_2$$

(A)

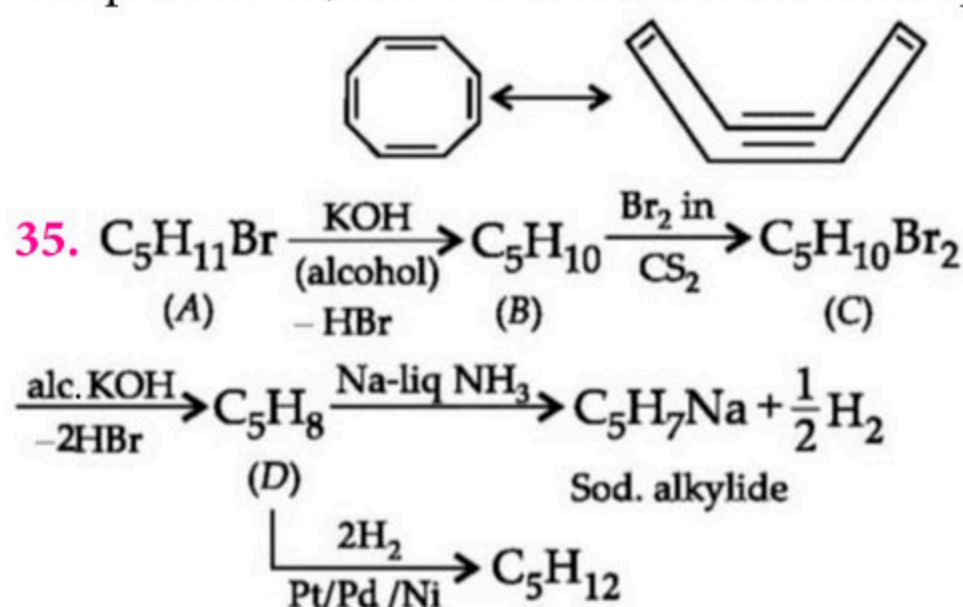
Propanol

(B)

Propene

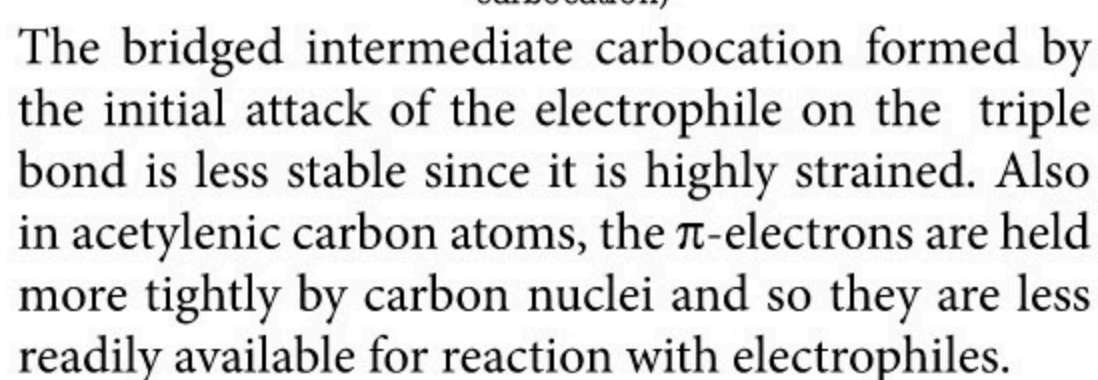
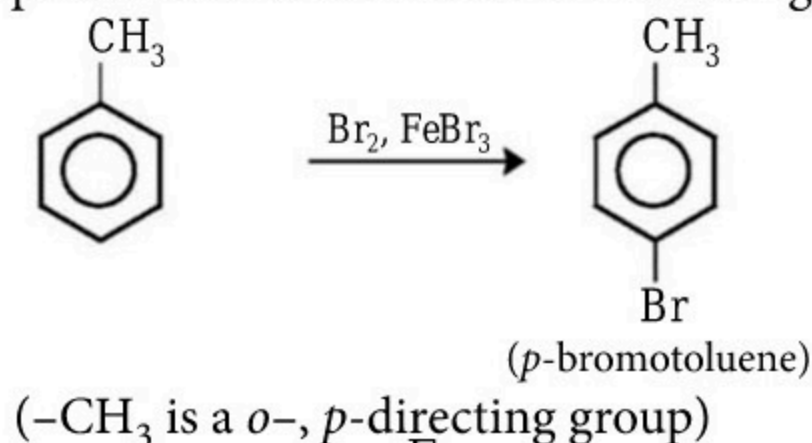
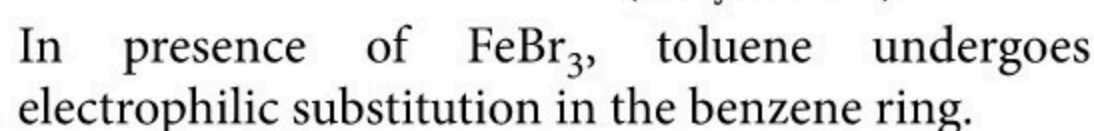

$$\begin{array}{ccc} \text{CH}_2 = \text{CH}_2 + \text{H}_2 & \xrightarrow[\text{or Pd}]{\text{Ni or Pt}} & \text{CH}_3 - \text{CH}_3 \\ \text{Ethene} & & \text{Ethane} \\ \text{CH}_3\text{C} \equiv \text{CH} + 2\text{H}_2 & \xrightarrow{\text{Ni or Pt}} & \text{CH}_3 - \text{CH}_2 - \text{CH}_3 \\ \text{Propyne} & & \text{Propane} \end{array}$$

(b) Cyclooctatetraene (COT) is not aromatic because of its non-planar tub-shaped structure. Although according to electron-count it seems to be an antiaromatic compound but, infact it is non-aromatic compound.



(a) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_2\text{Br}$
 (b) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}=\text{CH}_2$
 (c) $\text{CH}_3\text{CH}_2\text{CH}_2-\underset{\text{Br}}{\text{CH}}-\text{CH}_2\text{Br}$
 (c) $\text{CH}_3\text{CH}_2\text{CH}_2\text{C}\equiv\text{CH}$
n-Pentyne

(i) In presence of sunlight, toluene undergoes side chain bromination through a free radical mechanism.

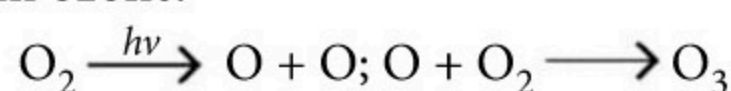

$$\left[\begin{array}{c} \text{---C}=\text{C---C}=\text{C---} \longleftrightarrow \text{---}\overset{+}{\text{C}}\text{---C}=\text{C---}\overset{-}{\text{C}}\text{---} \\ \text{---}\overset{-}{\text{C}}\text{---C}=\text{C---}\overset{+}{\text{C}}\text{---} \end{array} \right]$$

In it we find two structures as charged structures and they induce some double bond character in the central C—C bond and so this bond gets shortened.

(b) Industrial waste can be biodegradable as well as non-biodegradable. Biodegradable wastes are generated by cotton mills, paper mills and textile industries. Non-biodegradable wastes are generated by thermal power plants and by industries manufacturing aluminium. If they are not disposed of in a proper manner, then they become a serious threat to the environment.

Domestic waste includes paper pieces, glass, food wastes, etc. Some of these are non-biodegradable and pollute the environment and also some of them emit poisonous gases and pathogenic bacteria which are disease causing agents.

(c) The ozone is formed in the stratosphere in a two-step process. In the first step, the ultraviolet radiation coming from the sun have sufficient energy to split dioxygen (O_2) into two oxygen atoms. In the second step, these oxygen atoms react with more of dioxygen to form ozone.



OR

(a) While a compost pit can be a blessing for the agricultural field since it produces manure, it can also be source of trouble in the form of flies, foul odour and home for growth of bacteria, however, the negative effects can be done away with by making the pit at a place away from the residential area preferably somewhere in the field itself. Equally important is covering the pit with a suitable lid to prevent foul odour. In such a way one can derive the benefits of a compost pit.

(b) Chemical Oxygen Demand (COD) is a measure of the capacity of water to consume oxygen during the decomposition of organic matter and the oxidation of inorganic chemicals such as ammonia and nitrite. It is measured by treating the given sample of water with an oxidizing agent, generally $K_2Cr_2O_7$ in presence of dilute H_2SO_4 .

(c) The depletion of ozone layer is termed as ozone hole.

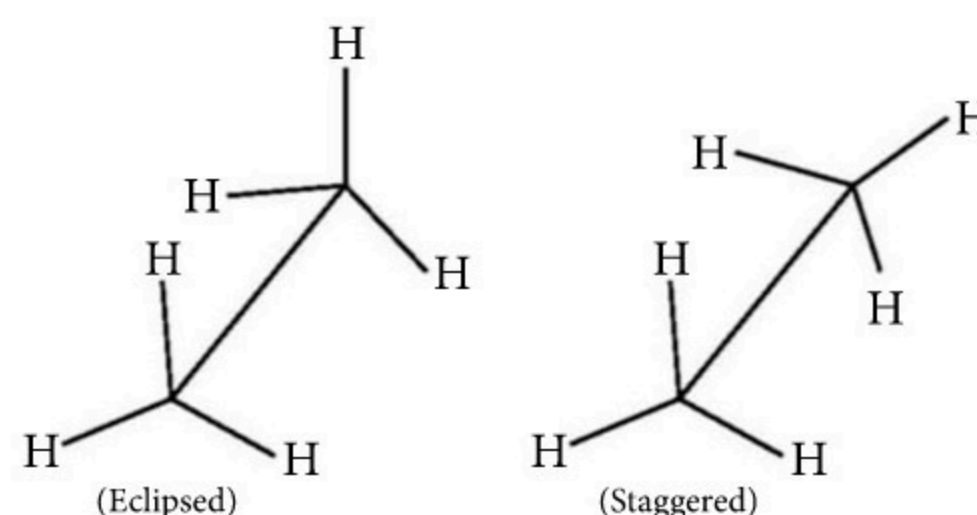
Ozone layer is responsible for prevention of infiltration of UV rays which has the potential to cause serious damage to plants, animals and human life. Due to depletion of this ozone layer, these harmful rays will find an easy route into the earth's atmosphere and create problems such as mutation of cells leading to cancer of the skin or increased transpiration in plants and reduced water level in soil. Increase in UV radiations damages paints and fibres causing them to fade faster.

37. (i) (a) $I_2 < Br_2 < Cl_2 < F_2$

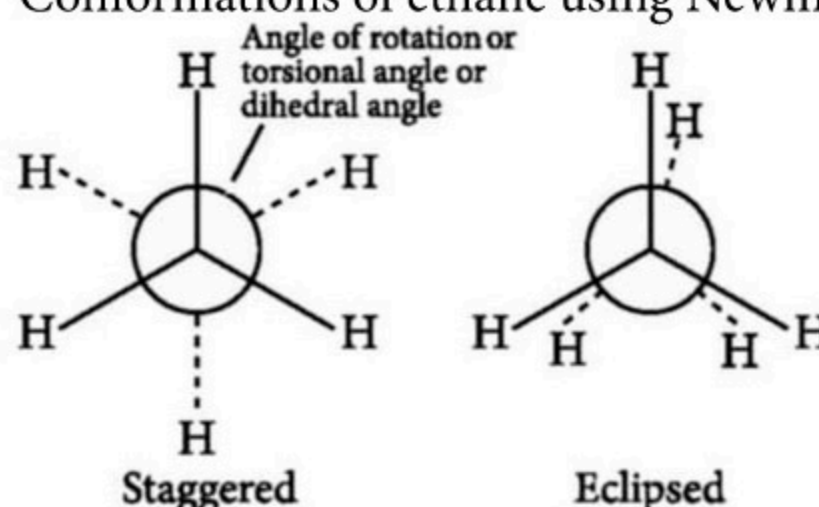
(b) More the number of CH_3 groups, more the H-atom, greater is the heat of combustion. Thus, the increasing order of heat of combustion is (iii) < (iv) < (i) < (ii).

(c) C_2H_2 (120 pm) < C_2H_4 (134 pm) < C_2H_6 (154 pm)

(ii) Conformations of ethane using sawhorse formula :

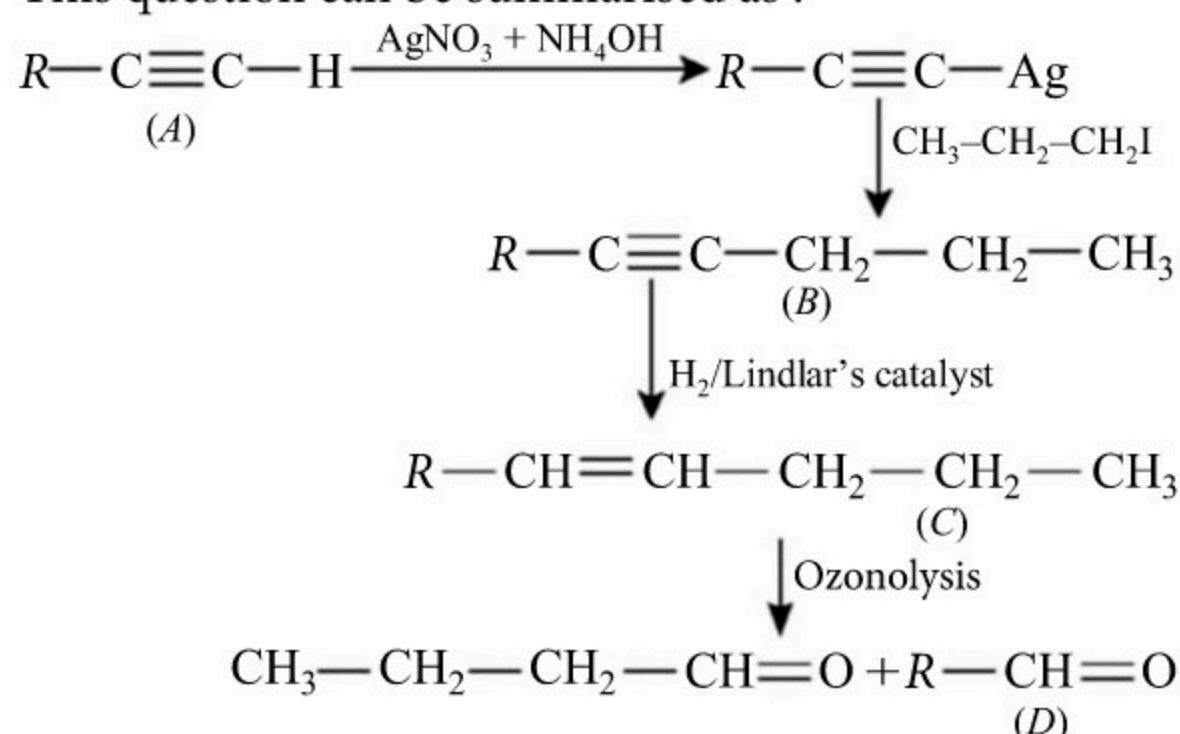


Conformations of ethane using Newman projection :

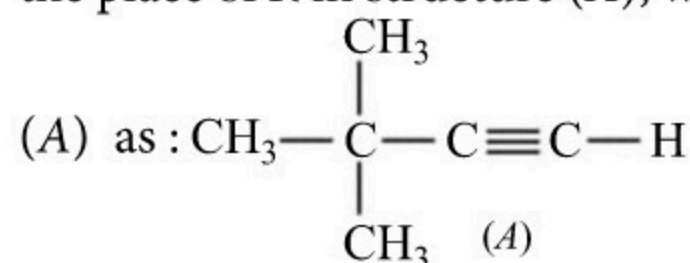


OR

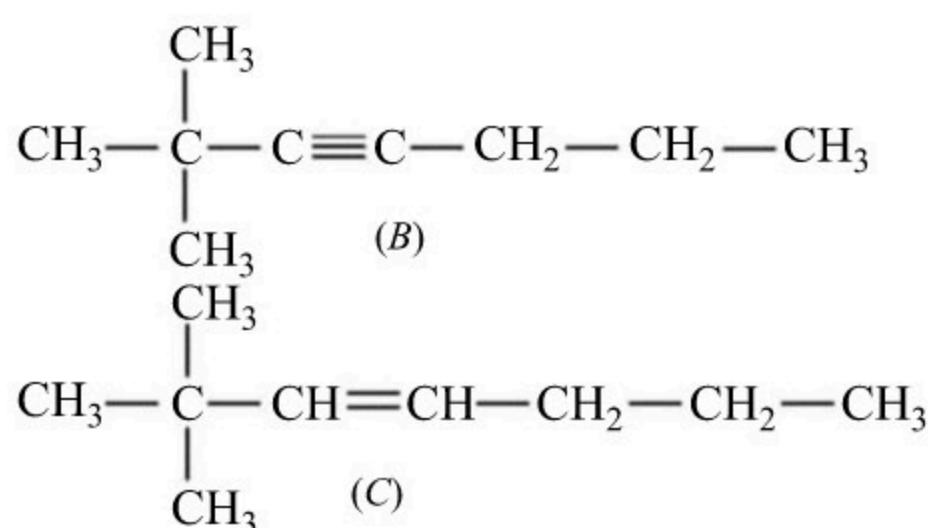
This question can be summarised as :



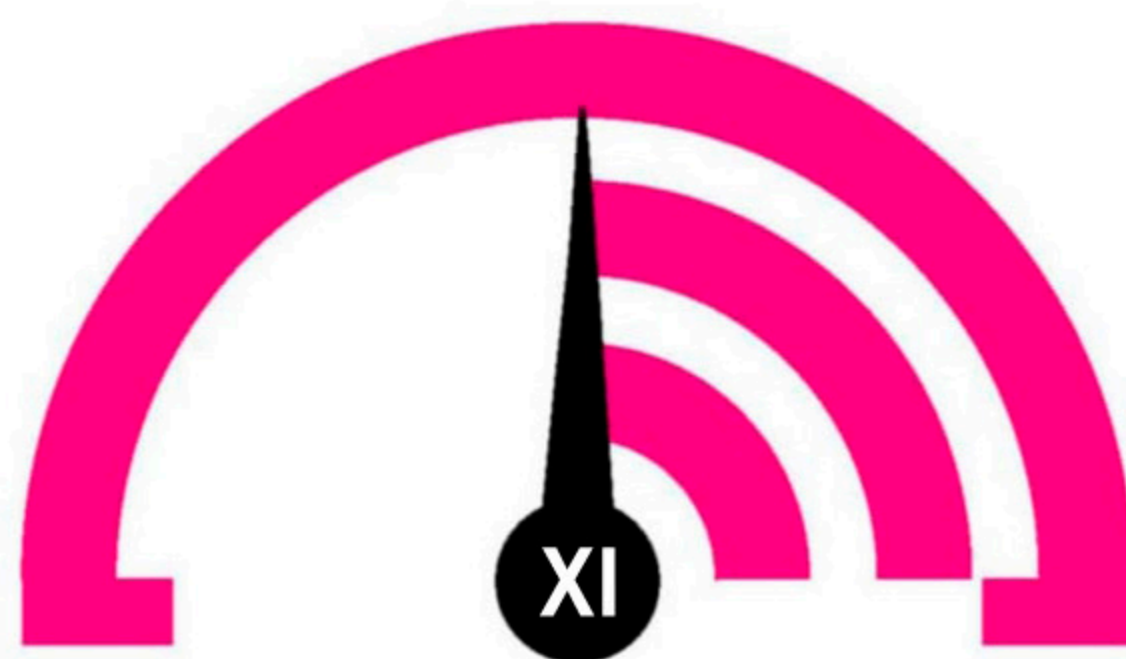
By the question it is clear that (D) will be 2, 2-dimethylpropanal. On comparing $RCHO$ and 2, 2-dimethylpropanal we can say that alkyl part of (D) is $(CH_3)_3C$ (tertiary butyl). By placing *t*-butyl group at the place of R in structure (A), we can write structure of



By placing the value of R in (B) and (C) we can write their structures as :



MONTHLY TEST DRIVE



This specially designed column enables students to self analyse their extent of understanding of specified chapters. Give yourself four marks for correct answer and deduct one mark for wrong answer. Self check table given at the end will help you to check your readiness.

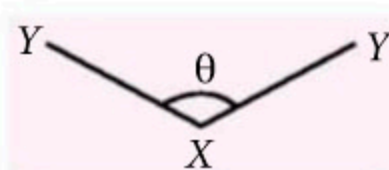
Total Marks : 120

Classification of Elements and Periodicity in Properties | Chemical Bonding and Molecular Structure

Time Taken : 60 Min.

NEET

Only One Option Correct Type

- The electronic configuration of two elements are given as $s^2p^6d^{10}$ and s^2p^6 . To which family these elements belongs?
(a) Nitrogen family (b) Halogen family
(c) Inert gases (d) Transition elements.
- In which of the following molecules/ions, the central atom does not involve d -orbital in the hybridisation process?
(a) I_3^- (b) SF_6
(c) $[Cu(NH_3)_4]^{2+}$ (d) SO_4^{2-}
- Among the following species, identify the isostructural pairs
 $NF_3, NO_3^-, BF_3, H_3O^+, HN_3$
(a) $[NF_3, NO_3^-]$ and $[BF_3, H_3O^+]$
(b) $[NF_3, HN_3]$ and $[NO_3^-, BF_3]$
(c) $[NF_3, H_3O^+]$ and $[NO_3^-, BF_3]$
(d) $[NF_3, H_3O^+]$ and $[HN_3, BF_3]$
- Which of the following statements is not correct from the molecular orbital theory?
(a) Be_2 is not a stable molecule.
(b) He_2 is not stable but He_2^+ is expected to exist.
(c) Bond strength of N_2 is maximum amongst the homonuclear diatomic molecules belonging to the second period.
(d) The order of energies of molecular orbitals in N_2 molecule is,
 $\sigma 1s < \sigma^* 1s < \sigma 2s < \sigma^* 2s < \sigma 2p_z < (\pi 2p_x = \pi 2p_y) < (\pi^* 2p_x = \pi^* 2p_y) < \sigma^* 2p_z$
- For the element (X), student (A) measured its radius as 102 nm, student (B) as 103 nm and (C) as 100 nm using same apparatus. Their teacher explained that measurements were correct by saying that recorded values by (A), (B) and (C) are
(a) crystal, van der Waals' and covalent radii
(b) covalent, crystal and van der Waals' radii
(c) van der Waals', ionic and covalent
(d) none of the above is correct.
- Which bond angle θ would result in the maximum dipole moment for the triatomic molecule XY_2 as shown below?
(a) 90° (b) 120°
(c) 150° (d) 180°

- Which of the following does not reflect the periodicity of elements?
(a) Bonding behaviour (b) Electronegativity
(c) Ionisation potential (d) Neutron/proton ratio
- Among KO_2 , AlO_2^- , BaO_2 and NO_2^+ , unpaired electron is present in
(a) NO_2^+ and BaO_2 (b) KO_2 and AlO_2^-
(c) KO_2 only (d) BaO_2 only.
- Element with atomic number 115 has configuration as _____ and with most stable cation as _____
(a) $[Rn] 5f^{14} 6d^{10} 7s^2 7p^3$ M^{3+}
(b) $[Rn] 7s^2 5d^{10} 4f^{14} 7p^3$ M^{5+}
(c) $[Rn] 7s^2 5d^{10} 4f^{14} 7p^3$ M^+
(d) $[Rn] 5d^{10} 4f^{14} 7p^6$ M^{5+}

10. Two p -block elements x (outer configuration $ns^2 np^3$) and z (outer configuration $ns^2 np^4$) occupy neighbouring positions in a period. Using this information which of the following is correct with respect to their ionisation potential I_x and I_z .
- (a) $I_x > I_z$ (b) $I_z > I_x$
 (c) $I_z = I_x$ (d) Relation between I_x and I_z is uncertain
11. A diatomic molecule has a dipole moment of 1.2 D. If the bond distance is 1 Å, what percentage of electronic charge exists on each atom?
- (a) 12% (b) 19% (c) 25% (d) 29%
12. A molecule may be represented by three structures having energies E_1 , E_2 and E_3 , respectively. The energies of these structures follow the order $E_3 < E_2 < E_1$, respectively. If the experimental bond energy of the molecule is E_0 , the resonance energy is
- (a) $(E_1 + E_2 + E_3) - E_0$ (b) $E_0 - E_3$
 (c) $E_0 - E_1$ (d) $E_0 - E_2$

Assertion & Reason Type

Directions : In the following questions, a statement of assertion is followed by a statement of reason. Mark the correct choice as :

- (a) If both assertion and reason are true and reason is the correct explanation of assertion.
 (b) If both assertion and reason are true but reason is not the correct explanation of assertion.
 (c) If assertion is true but reason is false.
 (d) If both assertion and reason are false.

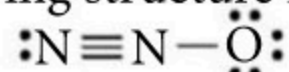
13. **Assertion :** F atom has less negative electron gain enthalpy than Cl atom.

Reason : Additional electrons are repelled more effectively by $3p$ -electrons in Cl than by $2p$ -electrons in F atom.

14. **Assertion :** The second electron gain enthalpy of an element is taken as positive.

Reason : Energy is released when an electron is added to the atom.

15. **Assertion :** Following structure is acceptable

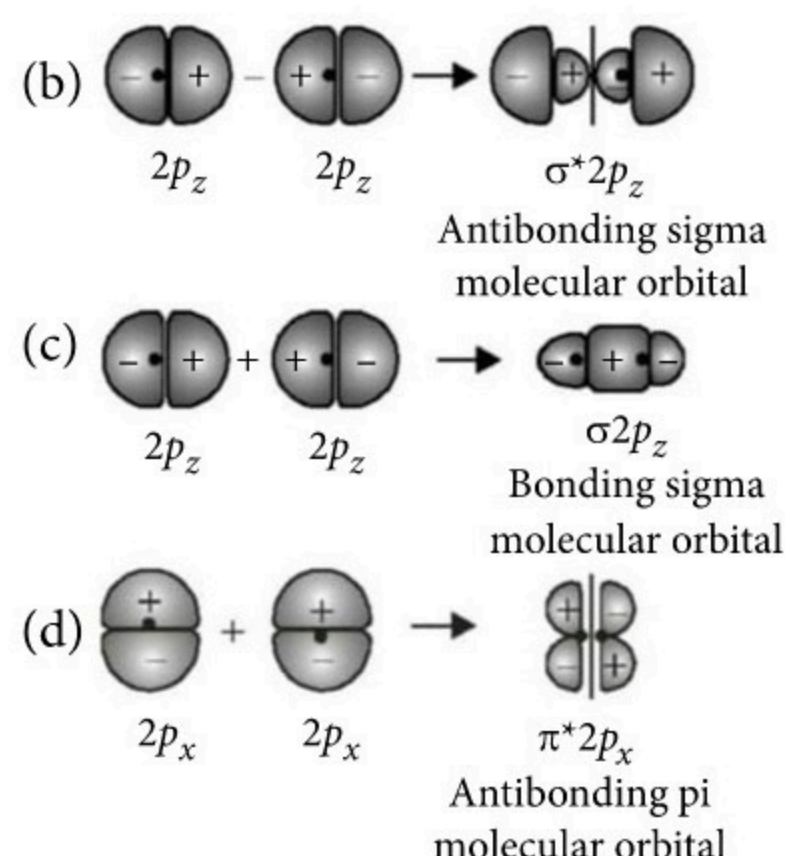
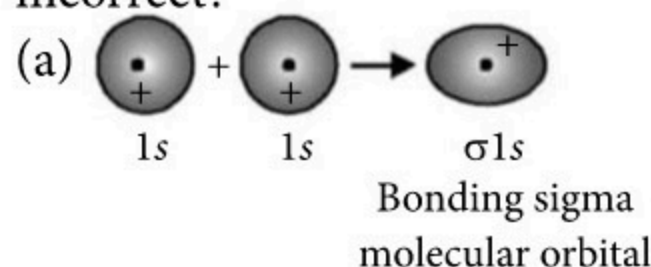


Reason : Octet rule is followed for each atom, central N has positive charge and oxygen has negative charge.

JEE MAIN / ADVANCED

Only One Option Correct Type

16. Which of the following combination of orbitals is incorrect?



17. The first ionisation potential of Na, Mg, Al and Si are in the order

- (a) $\text{Na} < \text{Mg} > \text{Al} < \text{Si}$ (b) $\text{Na} > \text{Mg} > \text{Al} > \text{Si}$
 (c) $\text{Na} < \text{Mg} < \text{Al} > \text{Si}$ (d) $\text{Na} > \text{Mg} > \text{Al} < \text{Si}$

18. Which of the following statements is not correct?

- (a) Hybridisation is the mixing of atomic orbitals and their simultaneous combination into molecular orbitals.
 (b) sp^2 hybrid orbitals are formed from two p -atomic orbitals and one s -atomic orbital.
 (c) dsp^2 hybrid orbitals are all at 90° to one another.
 (d) d^2sp^3 hybrid orbitals are directed towards the corners of a regular octahedron.

19. Electronic configurations of four elements A, B, C and D are given below:

- (i) $1s^2 2s^2 2p^6$ (ii) $1s^2 2s^2 2p^4$
 (iii) $1s^2 2s^2 2p^6 3s^1$ (iv) $1s^2 2s^2 2p^5$

Which of the following is the correct order of increasing tendency to gain electron?

- (a) (i) < (iii) < (ii) < (iv) (b) (i) < (ii) < (iii) < (iv)
 (c) (iv) < (ii) < (iii) < (i) (d) (iv) < (i) < (ii) < (iii)

More than One Options Correct Type

20. Which one of the following is incorrect electronic configuration for diatomic nitrogen?

(a)	(b)	(c)	(d)
σ_{2p}^* —	σ_{2p}^* —	σ_{2p}^* —	σ_{2p}^* —
π_{2p}^* —	π_{2p}^* —	π_{2p}^* —	π_{2p}^* $\uparrow\downarrow$
σ_{2p} $\uparrow\uparrow\uparrow\uparrow$	σ_{2p} $\uparrow\uparrow\uparrow\uparrow$	σ_{2p} $\uparrow\downarrow$	π_{2p} $\uparrow\downarrow$
π_{2p} $\uparrow\downarrow\uparrow\downarrow$	π_{2p} $\uparrow\downarrow$	π_{2p} $\uparrow\downarrow\uparrow\downarrow$	σ_{2p} $\uparrow\downarrow$
σ_{2s}^* $\uparrow\downarrow$	σ_{2s}^* $\uparrow\downarrow$	σ_{2s}^* $\uparrow\downarrow$	σ_{2s}^* $\uparrow\downarrow$
σ_{2s} $\uparrow\downarrow$	σ_{2s} $\uparrow\downarrow$	σ_{2s} $\uparrow\downarrow$	σ_{2s} $\uparrow\downarrow$
σ_{1s}^* $\uparrow\downarrow$	σ_{1s}^* $\uparrow\downarrow$	σ_{1s}^* $\uparrow\downarrow$	σ_{1s}^* $\uparrow\downarrow$
σ_{1s} $\uparrow\downarrow$	σ_{1s} $\uparrow\downarrow$	σ_{1s} $\uparrow\downarrow$	σ_{1s} $\uparrow\downarrow$

21. In the following case(s), hybridisation of the underlined atom is affected
- (a) $\underline{\text{P}}\text{Cl}_5$ (solid) dissociates into PCl_4^+ and PCl_6^-
 (b) LiH reacts with $\underline{\text{Al}}\text{H}_3$ forming LiAlH_4
 (c) $\underline{\text{N}}\text{H}_3$ is protonated
 (d) $\text{H}_3\underline{\text{P}}\text{O}_2$ is heated forming PH_3 and H_3PO_3 .
22. Which of the following pairs of elements have almost similar atomic radii?
- (a) Mo, W (b) Zr, Hf
 (c) Nb, Ta (d) Zn, Cd
23. Which combinations of the compounds and their geometry are correct?
- (a) HgCl_2 —Linear (b) ClF_2^- —V-shaped
 (c) ClF_3 —T-shaped (d) ICl_4^- —Square planar

Numerical Value Type

24. The first four ionization energy values of an element are 191, 578, 872 and 5962 kcal. The number of valence electrons in the element is
25. The compound MX_4 is tetrahedral. The number of $\angle\text{XMX}$ formed in the compound is
26. The bond dissociation energies of H—H , C—C and C—H bonds respectively are 104.2, 83.1 and 98.8 kcal mol⁻¹. The electronegativity of carbon is

Matrix Match Type

Answer the following questions (27 and 28) by appropriately matching the columns based on the information given in the passage :

The electrons in a molecule or a molecular ion occupy molecular orbitals according to the same rules as followed by atomic orbitals in atoms. Bond order is half of the difference of electrons in bonding orbitals and antibonding orbitals and helps to compare the properties of different molecules or their ions.

Match the species (in column I) with bond-order (in column II) and number of unpaired electrons (in column III).

Column-I (Species)			Column-II (Bond-order)	Column-III (Unpaired electron)	
I.	Be_2^+	(i)	2	P.	2
II.	O_2	(ii)	2.5	Q.	0
III.	O_2^+	(iii)	0.5	R.	1
IV.	O_2^{2-}	(iv)	1.0	S.	1

27. Which of the following has the correct combination considering column I, column II and column III ?
- (a) (I) \rightarrow (iii) \rightarrow (R) (b) (II) \rightarrow (ii) \rightarrow (P)
 (c) (III) \rightarrow (iv) \rightarrow (Q) (d) (IV) \rightarrow (i) \rightarrow (S)
28. Which of the following has the correct combination considering column I, column II and column III ?
- (a) (I) \rightarrow (i) \rightarrow (R) (b) (II) \rightarrow (ii) \rightarrow (P)
 (c) (III) \rightarrow (iii) \rightarrow (S) (d) (IV) \rightarrow (iv) \rightarrow (Q)

Answer the following questions (29 and 30) by appropriately matching the columns based on the information given in the passage :

The first ($\Delta_i H_1$) and the second ($\Delta_i H_2$) ionisation enthalpies in kJ mol⁻¹ and the electron gain enthalpy in kJ mol⁻¹ of a few elements are given below :

Column-I		Column-II			
(Elements)			ΔH_1	ΔH_2	$\Delta_{eg} H_1$
P.	Most reactive non-metal	I.	419	3051	-48
Q.	Most reactive metal	II.	1681	3374	-328
R.	Least reactive element	III.	738	1451	-40
S.	Metal forming binary halide	IV.	2372	5251	+48

29. Which of the following has the correct combination considering column I and column II ?
- (a) P \rightarrow I (b) Q \rightarrow III
 (c) R \rightarrow IV (d) S \rightarrow II
30. Which of the following has the correct combination considering column I and column II ?
- (a) P \rightarrow IV (b) Q \rightarrow II
 (c) R \rightarrow I (d) S \rightarrow III



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CHECK YOUR PERFORMANCE

No. of questions attempted
 No. of questions correct
 Marks scored in percentage

If your score is

- > 80% Your preparation is going good, keep it up to get high score.
 60-80% Need more practice, try hard to score more next time.
 <60% Stress more on concepts and revise thoroughly.

At a Glance

CHEMISTRY today

2019

MONTHS	Solved Papers (2019)	Practice Papers (2019 & 2020)	Focus/Brush up for NEET JEE	Concept Map	Others
JANUARY	—	CBSE Drill (Hydrocarbon Environmental Chemistry) CBSE Drill Practice Paper XII	Unit-7 : Organic Chemistry-Some Basic Principles and Techniques (XI) Unit-7 : Organic Compounds Containing Nitrogen, Biomolecules (XII)	Condensation Reactions	Be JEE Ready, Brush Up Your Concept (XII & XIII), Monthly Tune Up (The <i>s</i> -Block Elements, The <i>p</i> -Block Elements Group 13-14) (XI) Aldehydes, Ketones and Carboxylic Acids (XII), Chemistry Musing Problem Set 66, Chemistry Musing Solution Set 65, Be JEE Ready, Be NEET Ready.
FEBRUARY	JEE Main	CBSE Drill (XI) Practice Paper (2019), CBSE Drill (XII) Practice Paper (2019)	Unit-8 : Hydrocarbons and Environmental Chemistry (XI), Unit-8 : Polymers, Chemistry in Everyday Life (XII)	Essentials of Chemistry	Be NEET Ready, Be JEE Ready, Brush Up Your Concept (XI), (XII), Monthly Tune Up (XI), Organic Chemistry-Some Basic Principles and Techniques, Organic Compound Containing Nitrogen (XII), Chemistry Musing Problem Set 67, Concept Booster, Chemistry Musing Solution Set 66.
MARCH	JEE Main	NEET Practice Paper 2019, Gear Up for JEE Main, BITSAT Practice Paper	Unit-9: Principles Related to Practical Chemistry (XII)	Essentials of Chemistry	Be JEE Ready, Be NEET Ready, Brush Up Your Concepts (XI), (XII), Monthly Tune Up, Hydrocarbon Environmental Chemistry (XI), Chemistry Musing Problem Set 68, Chemistry Musing Solution Set 67.
APRIL	CBSE Board (XII)	Gear Up for JEE Main, NEET Practice Paper, JEE Advanced Practice Paper 2019, BITSAT Practice Paper 2019, AIIMS	—	Comparative Study of KMnO_4 , $\text{K}_2\text{Cr}_2\text{O}_7$ and H_2O_2	JEE/AIIMS Workouts, Concept Booster, Chemistry Musing Solution Set-68, Be NEET Ready, Monthly Tune Up : Practice Paper (XI), Practice Paper (XII), Chemistry Musing Problems Set 69.
MAY	JEE Main	JEE Advanced Practice Paper, AIIMS, JIPMER	—	Interconversions of Organic Functional Groups	Exam Cafe, Olympiad Corner, Concept Booster, Chemistry Musing Problem Set 70, Chemistry Musing Solution Set 69.
JUNE	NEET Kerala PET, JEE Main Karnataka CET, J & K CET	CBSE Warm Up (XII) (Solutions/Electrochemistry)	—	Essentials of Physical Chemistry	Chemistry Musing Problem Set 71, Get Set Go for NEET (XI), Chemistry Musing Solution Set 70, Get Set Go for JEE (XII), NCERT Extract, Olympiad Corner.
JULY	JEE Advanced	Series I : CBSE Warm Up: Some Basic Concepts of Chemistry, Structure of Atom (XI), Series 2 : Electrochemistry, Chemical Kinetics, Surface Chemistry	Unit-I : Solid State, Solutions (XII)	Stereoisomerism	Chemistry Musing Problem Set 72, Cracking the NEET Exam, Concept Booster, Rank Enhancer, Chemistry Musing Solution Set 71, Get Set Go for NEET (XII), Get Set Go for JEE (XI).
AUGUST	WB JEE	Series 2 : Classification of Elements and Periodicity in Properties, Chemical Bonding and Molecular Structure (XI) Series 3 : General Principles and Processes of Isolation of Elements, The <i>p</i> -Block Elements (Group 15 to 18)	Unit 2 : Classification of Elements and Periodicity in Properties, Chemical Bonding and Molecular Structure (XI) Unit 2 : Electrochemistry, Chemical Kinetics, Surface Chemistry (XII)	Graphical Representation of Gaseous Laws	Get Set Go for NEET (XI), Get Set Go for JEE (XII), Monthly Test Drive, Organic Chemistry-Some Basic Principles and Techniques (XI), Haloalkanes and Haloarenes, Alcohols, Phenols and Ethers, Chemistry Musing Problem Set 73, Concept Booster, Rank Enhancer, Chemistry Musing Solution Set 72.
SEPTEMBER	—	Series 3 : States of Matter (Gaseous and Liquids), Thermodynamics (XI) Series 4 : The <i>d</i> & <i>f</i> -Block Elements, Coordination Compounds (XII)	Unit 3 : States of Matter, (Gaseous and Liquids), Thermodynamics (XI) Unit 3 : General Principles and Processes of Isolation of Elements, The <i>p</i> -Block Elements (Group 15 to 18)	Specification of Configuration	Get Set Go for JEE (XI), Get Set Go for NEET (XII), Monthly Test Drive : Hydrocarbons (XI), Aldehydes, Ketones and Carboxylic Acids, Organic Compounds Containing Nitrogen (XII), Chemistry Musing Problem Set 74, Concept Booster, Rank Enhancer, Chemistry Musing Solution Set 73.
OCTOBER	—	Gear Up for JEE Main (2020) Series 4 : CBSE Warm Up, Equilibrium, Redox Reaction (XI), Series 5 : Haloalkanes and Haloarenes, Alcohols, Phenols and Ethers	Unit 4 : Equilibrium, Redox Reactions (XI) Unit 4 : The <i>d</i> - & <i>f</i> -Block Elements, Coordination Compounds (XII)	Integrated Rate Equation	Get Set Go for NEET (XI) Get Set Go for JEE (XII), Monthly Test Drive : Hydrogen, The <i>s</i> -Block Elements, Polymers, Biomolecules, Chemistry in Everyday Life (XII), Chemistry Musing Problem Set 75, Concept Booster, Rank Enhancer, Chemistry Musing Solution Set 74.
NOVEMBER	—	Gear Up for JEE Main (2020) Series 5 : Hydrogen, The <i>s</i> -Block Elements (XI) Series 6 : Aldehydes, Ketones and Carboxylic Acids, Amines (XII)	Unit 5 : Hydrogen, The <i>s</i> -Block Elements (XI) Unit 5 : Haloalkanes and Haloarenes, Alcohols, Phenols and Ethers.	Aromatic Compounds	Get Set Go for JEE (XI), Get Set Go for NEET (XII), Monthly Test Drive, The <i>p</i> -Block Elements (Group 15 to 18). Environmental Chemistry (XI), The Solid State, Solutions (XII), Chemistry Musing Problem Set 76, Concept Booster, Rank Enhancer, Chemistry Musing Solution Set 75.
DECEMBER	—	Gear Up for JEE Main (2020) Series 6 : The <i>p</i> -Block Elements, Organic Chemistry-Some Basic Principles and Techniques	Unit 6 : The <i>p</i> -Block elements (XI) Unit 6 : Aldehydes, Ketones and Carboxylic Acids.	Essentials of Inorganic Chemistry Part - I	Get Go for NEET (XI), Get Set Go for JEE (XII), Monthly Test Drive, Some Basic Concepts of Chemistry, Structure of Atom (XI), Electrochemistry, Chemical Kinetics (XII), Chemistry Musing Problem Set 77, Concept Booster, Rank Enhancer, Chemistry Musing Solution Set 76.

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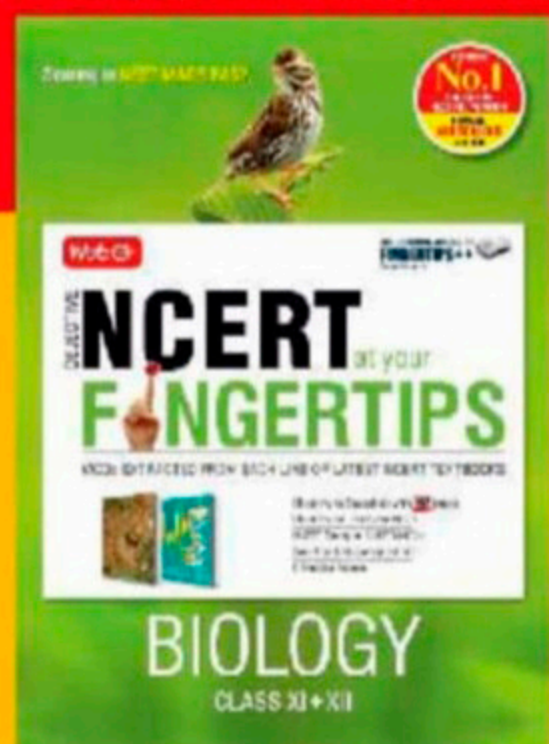
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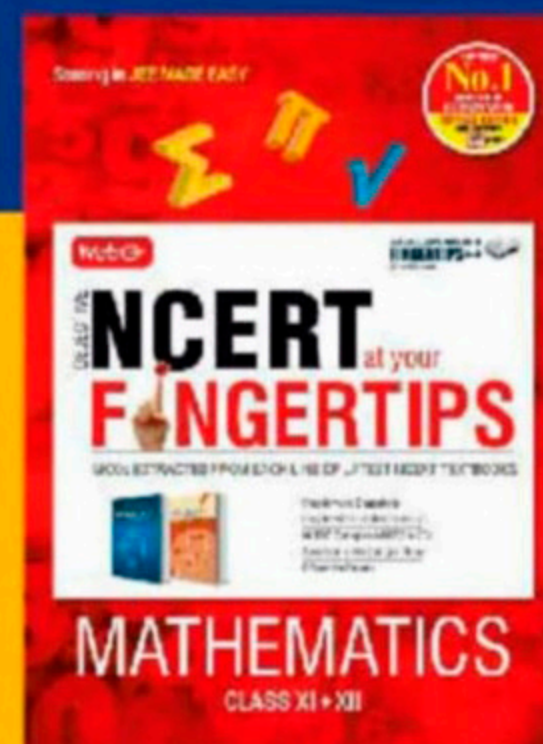
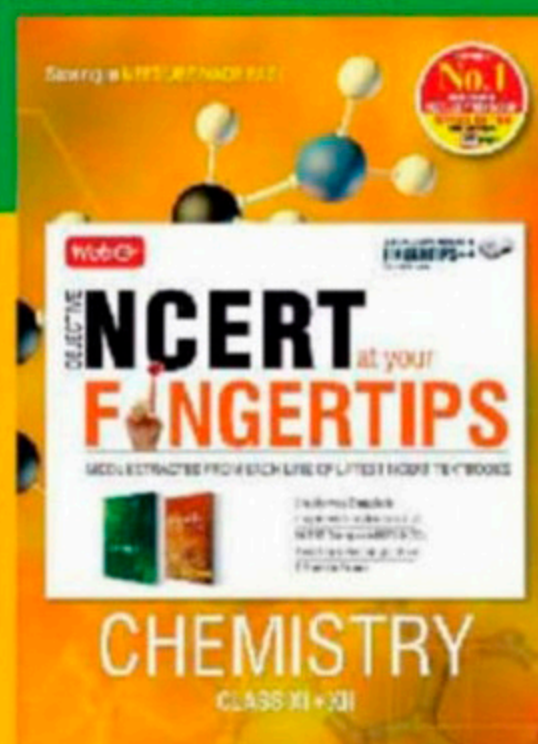
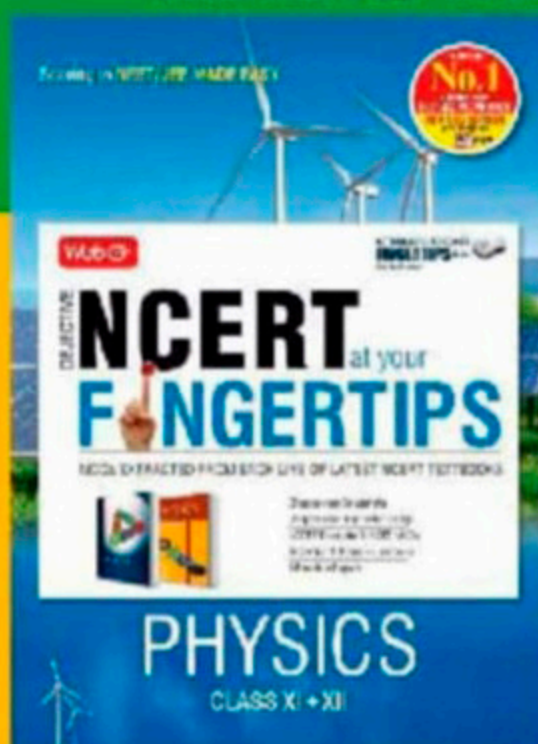
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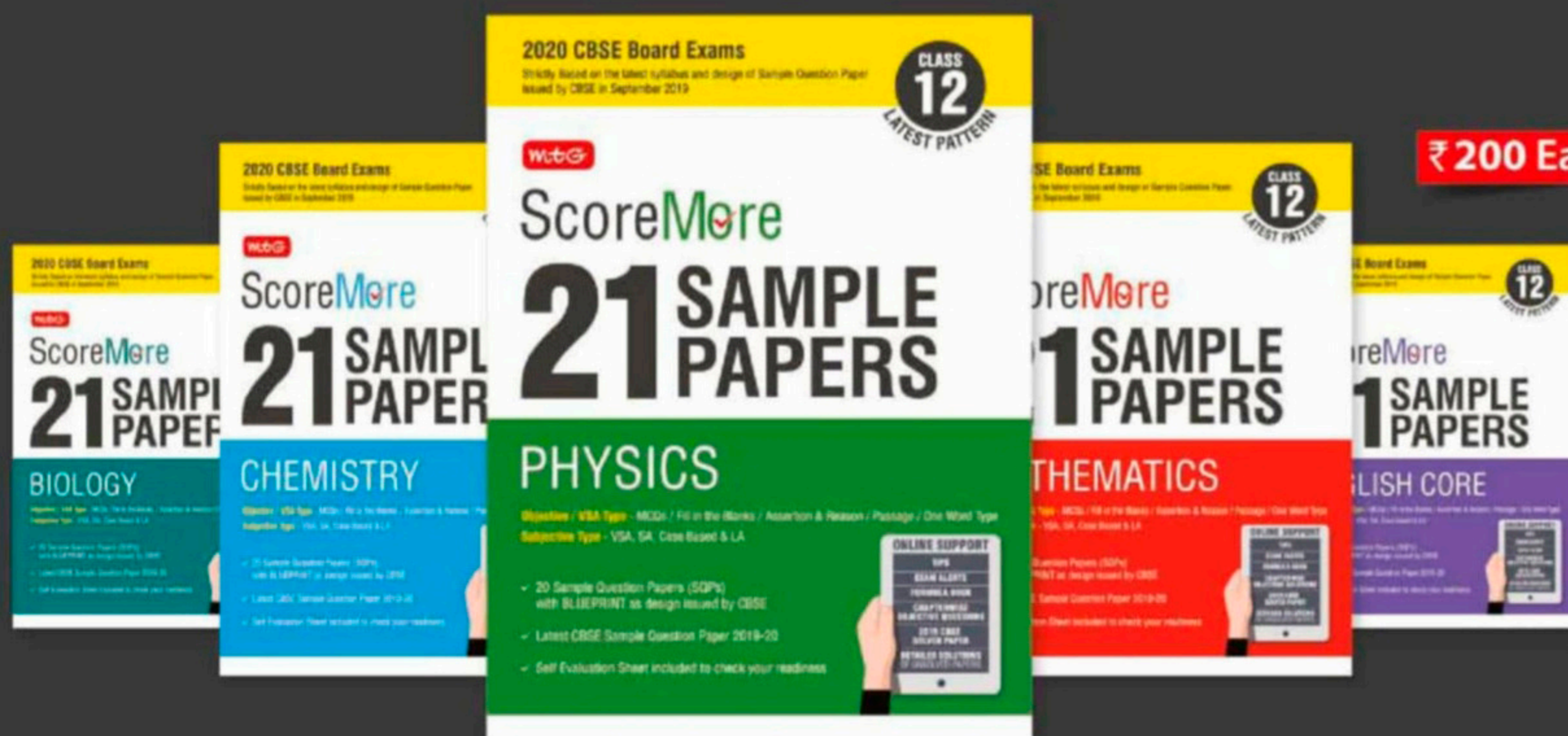
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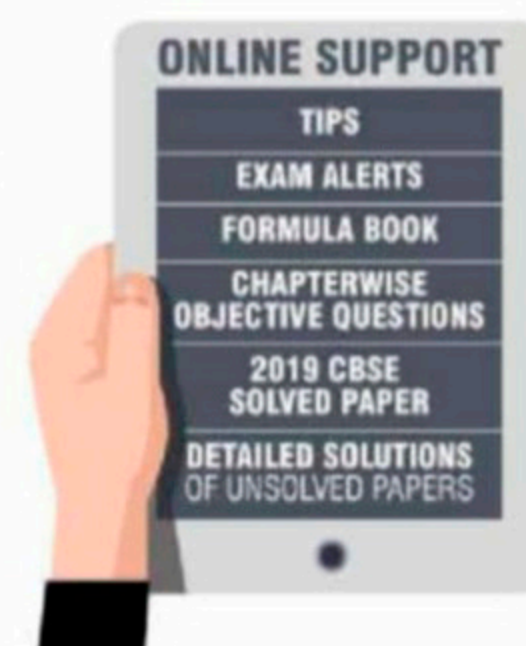
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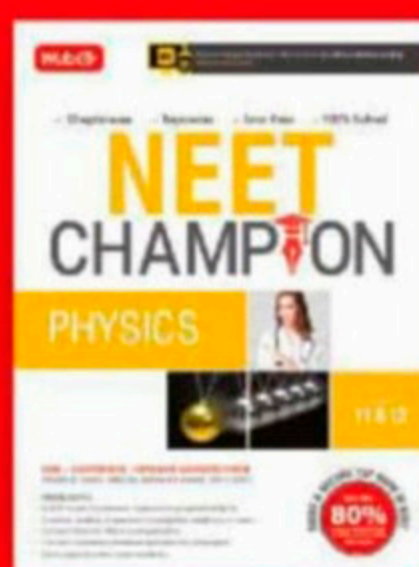
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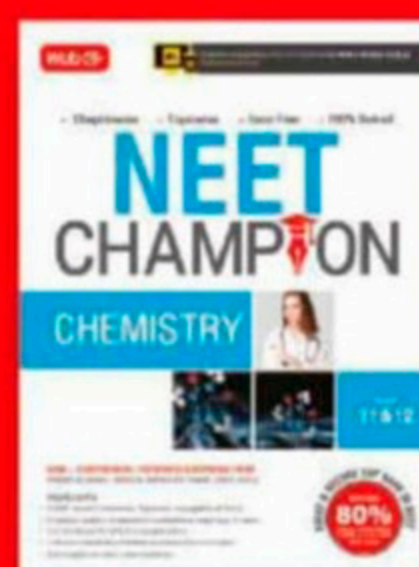
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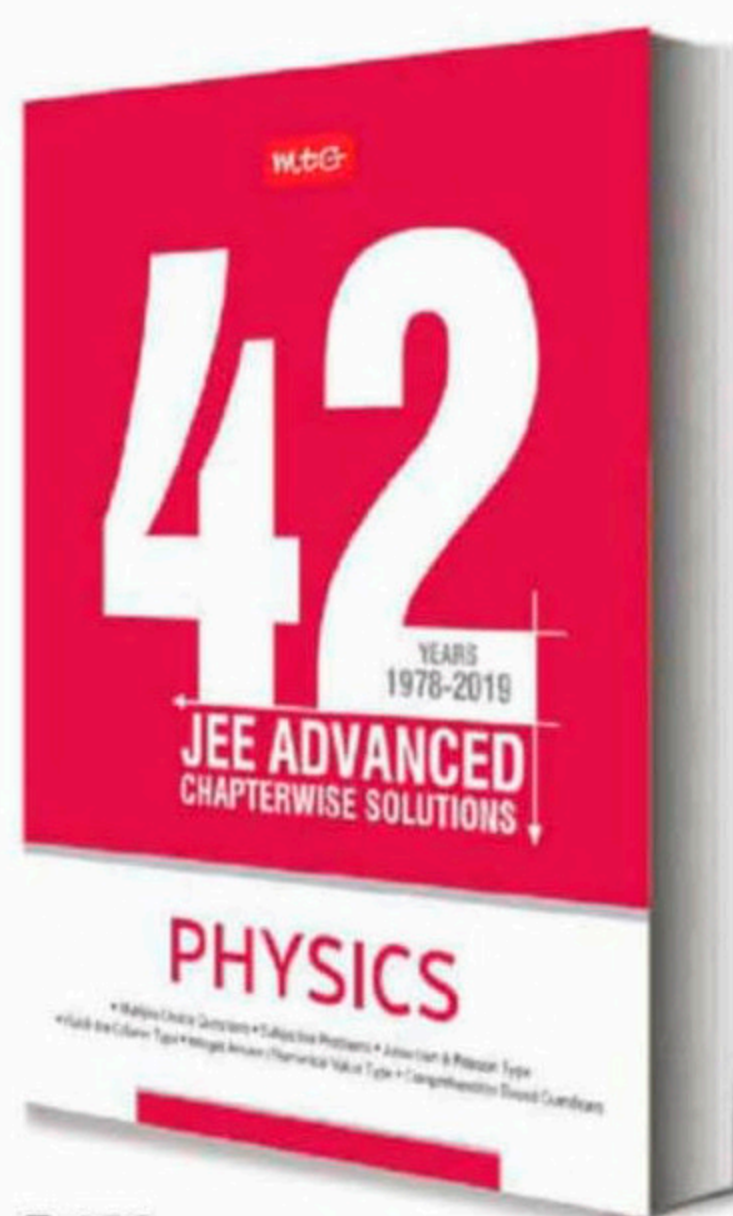


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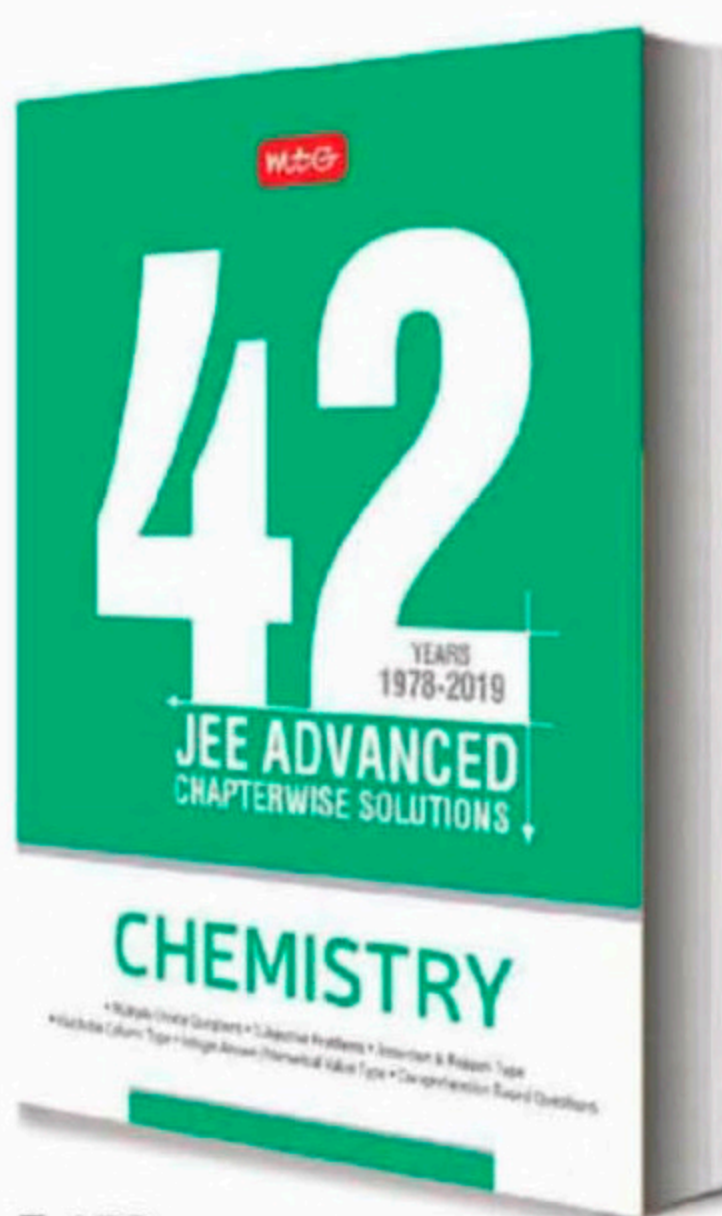
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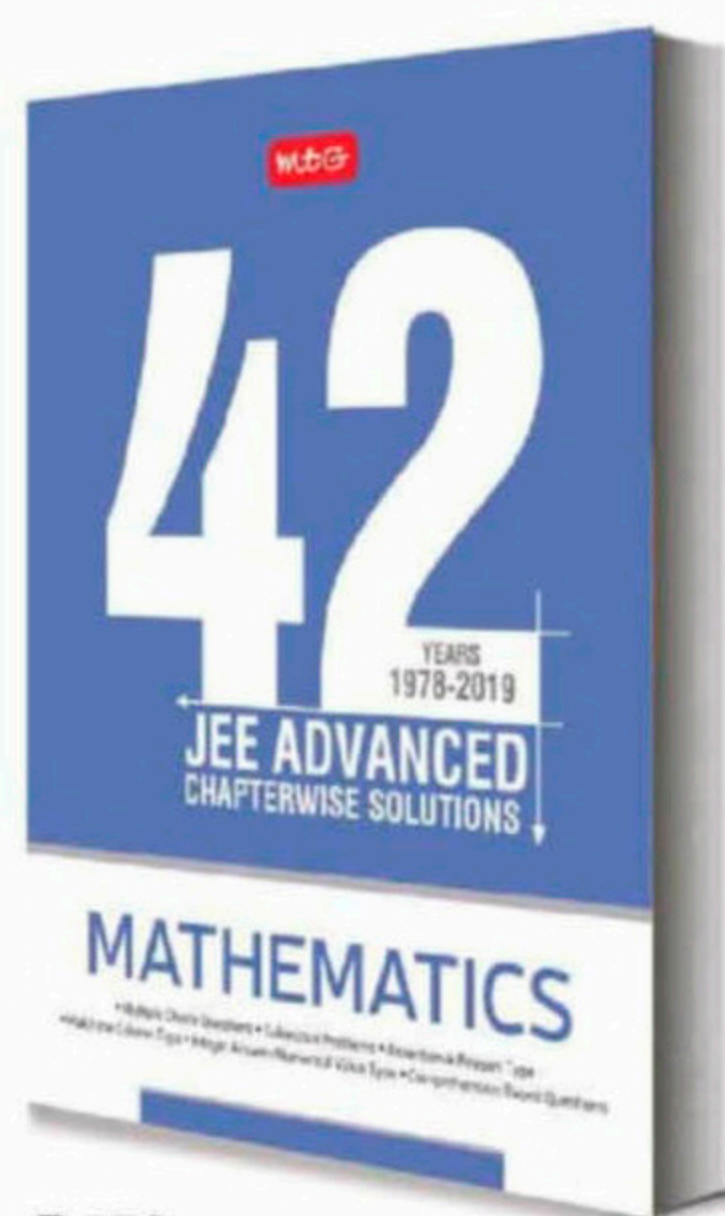
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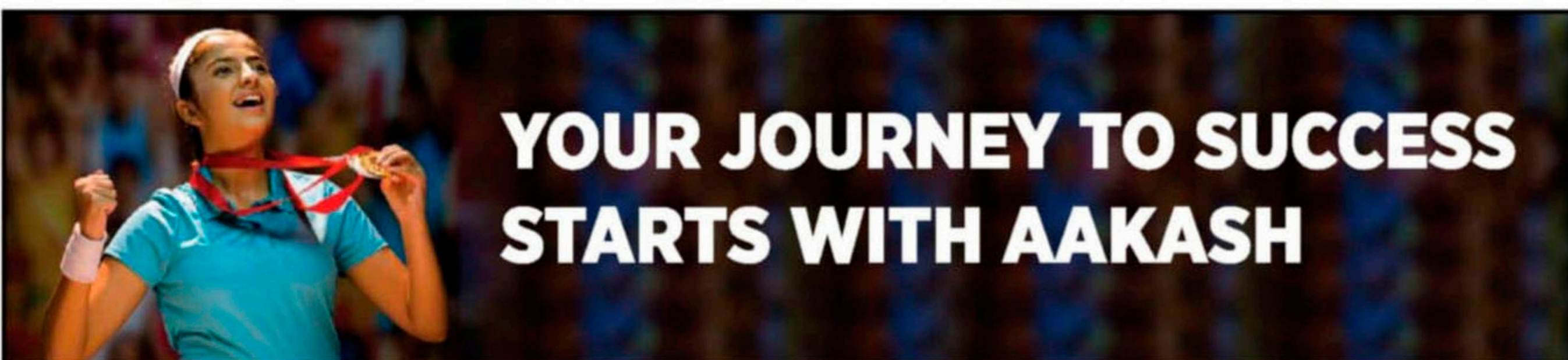
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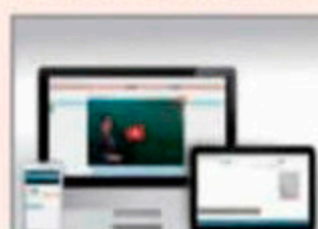


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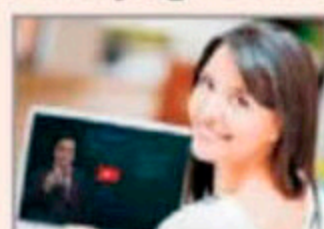
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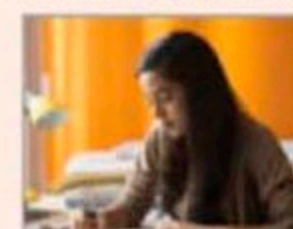
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